NOV 24 1924

Printed on Thin Paper for Foreign Circulation.

The Engineer.

Established 1856. Registered as a Newspaper.

OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C.2.

VOL. CXXXVIII.—No. 3593] LONDON: FRIDAY EVENING, NOVEMBER 7, 1924 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

Large Hydro-Electric Plant in Newfoundland.

A Zoelly Turbine Locomotive.

Institution of Civil Engineers—Presidential Address.

Joule's Law of Electric Heating.

100 Years of British Railways—No. XIX.

Lloyd's Register—Annual Report.

Modern Navigational Devices.

Wire-Drawing and Wire-Working Machinery (No. XV.).

PUBLIC NOTICES

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, REQUIRES:—
1. VACUUM AUTOMATIC BRAKE GEAR AND RIGGING.
2. STEAM ROAD ROLLERS.
Tenders due on the 21st November, 1924, for No. 1, and on the 25th November, 1924, for No. 2. Tender forms obtainable from above. 7451

Wanted, Aircraft Examiner for the Aeronautical Inspection Directorate for Airship Inspection. Applicants should state age, particulars of education, technical training, previous engineering experience, with full details of airship experience, ex-service qualifications, if any. Preference given to applicants holding Ground Engineer's Licence in "B" Category. Salary £320. Apply by letter only, SECRETARY, Air Ministry (D.O.A.I.), Alexandra House, Kingsway, W.C. 2. 7410

Required by the Government of NIGERIA for the PUBLIC WORKS DEPARTMENT:—
DRAUGHTSMAN (M/12,293). Salary £600, rising to £800 a year.
ARCHITECT (M/13,294). Salary £480, rising to £800 a year.
In both cases candidates must be between the age of 25 and 35, with experience of hospital and general building construction. Preference to A.R.I.B.A. In the case of the Draughtsman candidates must also possess good experience of quantities. The period of both engagements is for two tours of not less than 12 to 18 months' service. Free passage and quarters and liberal leave on full pay. Outfit allowance of £60 on first appointment.—Apply at once by letter, stating age, qualifications and experience, and quoting clearly the reference number of the post applied for, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1. 7305

Superintendent of ACCOUNTS and CORRESPONDENCE REQUIRED by the GOVERNMENT of HONG KONG for the PORT DEVELOPMENT DEPARTMENT for three years' service, with possible extension. Salary £800, rising to £900 a year, payable locally in dollars at the Government rate of exchange, at present fixed at 2s. to the dollar. In addition a strictly temporary exchange allowance is at present paid amounting to 20 per cent. of salary. Free passage. Candidates, aged 30-35, should be qualified accountants with experience in keeping engineering contractors' accounts.—Apply at once by letter, stating age and experience and whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/13,207 at head of letter. 7304

Traffic Manager Required for the GOVERNMENT RAILWAY of the FEDERATED MALAY STATES for three years, with prospect of the post becoming permanent and pensionable. Salary 1050 dollars per month plus a strictly temporary cost of living allowance of 10 per cent. of salary in the case of a single man and 20 per cent. for married men. No income tax is at present payable in the Federated Malay States. Free quarters provided, and, if married, for wife and children also, not exceeding four persons. Candidates, aged 30-40 years, should preferably have had experience in the Traffic Department of one of the British Railways.—Apply by letter not later than the 17th November, 1924, stating age and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1, quoting M/13,207 at head of letter. 7303

G. R.

GOVERNMENT SURPLUS.

TRANSFORMERS,

LYING AT H.M. FACTORY, GRETNA.

For Sale by Public Tender.

OWING TO THE URGENCY OF CLEARING THE AREA, WE ARE OFFERING FOR SALE BY TENDER A LARGE NUMBER OF TRANSFORMERS OF ALL SIZES UP TO 1000 K.V.A., 6300/440 VOLTS, 50 PERIODS.

TENDERS CLOSE ON 19th NOVEMBER.

Particulars and forms of Tender from GEORGE COHEN and ARMSTRONG DISPOSAL CORPORATION, Abbey House, 2, Victoria-street, Westminster, S.W. Telegrams, "Cohstrong Sowest." Tel. No. Victoria 8049/4. 7300

G. R.

For Sale by Public Tender,

TWO 4-TON ELECTRIC LUFFING JIB CRANES, of the 3-pad type, 47ft. By Stothert and Pitt, Ltd., Bath; lying at Beachley Shipyard, Monmouthshire.
Capacity 4 tons at any radius from 25ft. to 165ft.
Height of lift above ground 74ft.
All motors 440 volts, 3-phase, 50 periods, by British Westinghouse.
Have never been erected and are lying ready for shipment.
These cranes are offered for sale by public Tender, CLOSING 8 p.m., TUESDAY, NOVEMBER 18th, 1924.
Full particulars, Tender forms, and permit to view may be obtained from THE GEORGE COHEN and ARMSTRONG DISPOSAL CORPORATION, Abbey House, 2, Victoria-street, London, S.W. 1. 7301

Technical College, Bradford.

APPLICATIONS are INVITED for the APPOINTMENT of LECTURER in the Department of Civil Engineering, Architecture and Building.
An inclusive salary up to £425 (less the voluntary contribution of 5 per cent.) per annum will be paid to a candidate of suitable qualifications and experience. Candidates should possess a good degree in Civil Engineering and have had practical experience in public works and buildings.
Full particulars of the appointment and forms of application may be obtained from the Principal of the College, to whom the applications should be returned completed not later than 15th November, 1924.
7423 N. L. FLEMING, Town Clerk.

PUBLIC NOTICES

City of Birmingham Education COMMITTEE.

MUNICIPAL TECHNICAL SCHOOL.

HEAD OF ENGINEERING DEPARTMENT.

The Education Committee invite APPLICATIONS for APPOINTMENT to the POST OF HEAD of the ENGINEERING DEPARTMENT of the MUNICIPAL TECHNICAL SCHOOL. The post is a full-time one and the salary scale is £850 per annum, rising, subject to satisfactory service, by annual increments of £30 to £900 per annum.
The above-mentioned salary will be subject to a deduction of 5 per cent. in respect of the voluntary abatement of salaries, and also to the usual deduction of 5 per cent. in respect of contributions to the School Teachers' (Superannuation) Acts.
Particulars of the duties and conditions of the appointment, together with form of application, may be obtained from the Principal, Municipal Technical School, Suffolk street, Birmingham, or from the undersigned.
Canvassing will be a disqualification.
P. D. JONES, Chief Education Officer.
Education Office:
Margaret street, Birmingham.
7th November, 1924. 7400

Administrative County of LONDON.

NORTH-WESTERN STORM RELIEF SEWER.

CONTRACT NO. 1.

The London County Council invites TENDERS for the CONSTRUCTION of a 9ft. 9in. internal diameter SEWER in CAST IRON with CONCRETE LINING of a total length of about 9695ft., from Clarendon-road, Kensington, to and including an outlet into the River Thames near Hammersmith Bridge; also a 4ft. internal diameter SEWER in CAST IRON with CONCRETE LINING of a total length of about 2375ft., from King-street, Hammersmith, to the Council's Pumping Station at St. James-street, Hammersmith, all in the Boroughs of Kensington and Hammersmith. The work also comprises Flap Chambers, Penstock Chamber, Weir Chamber, Tumbling Bays, &c.
Persons desiring to submit Tenders may obtain the form of Tender and contract, specification, bill of quantities and drawings on application on and after Monday, 10th November, 1924, to the Chief Engineer of the Council at the Old County Hall, Spring-gardens, S.W.1, upon payment of the sum of £10, which amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.
No Tender received by the Clerk of the Council after Twelve Noon on 2nd December, 1924, will be considered.
The Council does not bind itself to accept the lowest or any Tender.
JAMES BIRD,
7424 Clerk of the London County Council.

Bombay, Baroda, and Central INDIA RAILWAY COMPANY.

The Directors are prepared to receive up to Noon on Friday, 21st November, TENDERS for the SUPPLY of—
WHEELS AND AXLES FOR WAGONS.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 20s. each (which will not be returned). The Directors do not bind themselves to accept the lowest or any Tender.
By Order, G. G. S. YOUNG, Secretary.
Offices: 91, Petty France, Westminster, S.W. 1.
5th November, 1924. 7425

PUBLIC NOTICES

Aberdeen Corporation Electricity DEPARTMENT.

60-TON CRANE.

The Town Council of Aberdeen are prepared to receive TENDERS for the SUPPLY, DELIVERY and ERECTION in the Engine-room at the Ferryhill Power Station, Aberdeen, of an ELECTRICALLY OPERATED OVERHEAD TRAVELLING CRANE, suitable for dealing with loads up to 60 tons.
Specification, drawings, and form of Tender may be obtained from the undersigned on payment of a deposit of £2 2s., which will be refunded after receipt of a bona fide Tender and the return of all documents and drawings.
Extra copies of the specification may be obtained on payment of 10s. per copy, which will not be returnable.
Sealed Tenders, endorsed "Crane," to be addressed to the City Electrical Engineer, and delivered at his office, Millburn-street, Aberdeen, before Noon on Saturday, 22nd November, 1924.
The Town Council do not bind themselves to accept the lowest or any Tender.
J. ALEX. BELL,
City Electrical Engineer.
November, 1924. 7397

Belfast Harbour.

The Belfast Harbour Commissioners are prepared to receive TENDERS for the ERECTION of a GOODS SHED, to be constructed mainly of Steel and Corrugated Iron, on the east side of the Dufferin Dock, Belfast, in accordance with drawings which may be seen at the office of the Harbour Engineer, Mr T. S. Gilbert, M. Inst. C.E., from whom copies of the specification of works, form of Tender, and any further information may be obtained.
Tenders, on the special form provided for the purpose, should be addressed to the undersigned, and must be enclosed in a sealed envelope endorsed "Tender for Shed, Dufferin Dock," and delivered not later than Wednesday, the 10th December, 1924.
Alternative Tenders for Roofing the Shed with approved Asbestos Tiles in lieu of Corrugated Iron will be considered.
The Commissioners do not bind themselves to accept the lowest or any Tender.
M. J. WATKINS,
General Manager and Secretary.
Harbour Office,
Belfast, 4th November, 1924. 7426

City and South London Railway.

The Company have for DISPOSAL a QUANTITY of REDUNDANT PLANT recently used in connection with Tunnel Enlargements, including the following:—Grouting Pans, Hydraulic Shield Pumps, Open-top Cisterns, C-shape Steel Tipping and Mining Wagons, Steel Air Receivers, Air Compressor, Electric Motors, 14ft. Grab, Mechanical Erectors, Morris Overhead Electrical Runway.
Full particulars as to where the articles may be seen and other information can be obtained on application to the PURCHASING AGENT,
7389 55, Broadway, Westminster, S.W. 1.

The Guardians of the Poor of the Parish of Lambeth hereby invite TENDERS for SUPPLYING an ELECTRICALLY DRIVEN HYDRO EXTRACTOR to their Lambeth Hospital.
General description of machine required together with form of Tender, may be obtained from this office. Tenders are returnable on or before Tuesday, the 18th November, 1924.
The Guardians do not pledge themselves to accept the lowest or any Tender.
By Order,
JAMES R. GOLDSPINK,
Clerk to the Guardians.
Guardians' Offices:
128, Brook-street, Kennington, S.E. 11,
3rd November, 1924. 7429

PUBLIC NOTICES

In the High Court of Justice 1923 A. No. 591, Chancery Division.
Mr. Justice Russell.
In the Matter of ALLDAYS and ONIONS Limited Great Western Works, Small Heath, Birmingham.

Mr. C. Herbert Smith, Chartered Accountant, Phœnix Chambers, 84, Colmore-row, Birmingham, the Receiver and Manager of the above-named Company INVITES OFFERS to reach him on or before the 8th day of December 1924 for the above very well-known and old-established BUSINESS as a GOING CONCERN. The Assets consist of:—
(1) The Trade Names, Trade Marks and Goodwill.
(2) The extensive and well-built Freehold Works and Land known as "Great Western Works" and situate in Sydenham-road, Small Heath, Birmingham.
(3) The well-built Building known as Great Western Hall and situate in Sydenham-road, Small Heath, Birmingham. Leasehold for 99 years from 22nd March, 1894, at a Ground Rent of £10 14s. This property comprises the Canteen and Caretaker's House.
(4) The Fixed Plant and Machinery.
(5) Loose Plant, Dies, Tools and Patterns.
(6) Office Furniture and Fittings.
(7) Motor Vehicles.
(8) Stock at cost or under, about £24,000.
(9) Book Debts (optional), about £15,000.
The principal business of the Company consists of the manufacture of Fans, Blowers, Forges, Power Hammers, Hearths, Furnaces, Bellows, Anvils, Vices, Cycles and Carrier Tricycles. It has been established over 300 years and has regularly carried out contracts for the War Office, Admiralty, G.P.O., and other Government Departments, Crown Agents for the Colonies, India Office, Home and Foreign Railways, and principal commercial firms at home and abroad. The business has been carried on by the Receiver and Manager under the direction of the Court for the past 18 months, during which period a trading profit has been made.
Full particulars may be obtained from the Receiver and Manager, Mr. C. Herbert Smith, F.C.A., of the firm of C. Herbert Smith and Russell, Chartered Accountants, Phœnix Chambers, 84, Colmore-row, Birmingham; or from Messrs. Evershed and Tomkinson, Solicitors, 25, Temple-row, Birmingham; or from Messrs. Stow, Preston and Lyttleton, Solicitors, 12, Lincoln's Inn Fields, London, W.C. 7. 7422

IRONFOUNDERS' AND STRUCTURAL ENGINEERS' BUSINESS FOR SALE BY PRIVATE BARGAIN.

The Subscribers are Prepared to receive OFFERS as a GOING CONCERN for the old-established BUSINESS (including GOODWILL, GROUND, BUILDINGS, PLANT, MACHINERY, STOCKS, &c.) carried on by JAMES ALLAN SENIOR and SON, Limited (in liquidation), at ELMBANK FOUNDRY and LAMBHILL IRONWORKS, GLASGOW.
The ELMBANK FOUNDRY, which is situated in POSSIL-ROAD, GLASGOW, covers an area of fully 4 acres and contains Moulding, Dressing and Fitting Shops, Pattern Stores and Warehouses. The Foundry is capable of a large output of Rainwater Pipes, Gutters, Soil Pipes, &c., in addition to Ornamental Ironwork and Jobbing Work.
The LAMBHILL IRONWORKS cover an area of over 10 acres. These works are well equipped with modern machinery and tools, the lay-out being on the most up-to-date lines for the economical production of all classes of Constructional Steel Work.
The LAMBHILL PLANT includes one 15-Ton and two 5-Ton Overhead Electric Cranes, Straightening, Cropping, Punching, Shearing, Planing, and Sawing Machines, as well as several Batteries of up-to-date Drills, Plate Rolls, and Pneumatic Riveting Plant.
Both works are conveniently situated for transport facilities.
In addition to an old-established home trade, the company has valuable export connections.
The works may be viewed by arrangement with the Subscribers. Offers, which may be for each business separately, must be lodged with the Subscribers not later than Friday, 5th December, 1924, at Twelve o'clock Noon.
Further particulars can be obtained on application to
LYALL K. HUTCHISON,
T. L. McLINTOCK,
Joint Liquidators.
196, West George-street, Glasgow,
3rd November, 1924. 7431

The Great Indian Peninsula RAILWAY COMPANY, 48, Cophall-avenue, London, E.C. 2, invite TENDERS for:—
1. VOLUTE SPRINGS ..... Fig 2a. 64.
Tenders are due by 4 p.m. on 18th November, 1924. Tender forms obtainable at above address. Fees not returnable. 7409

PUBLIC NOTICES (continued) Page 2.

SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PATENTS, Page 3.
MISCELLANEOUS, Page 3.
PARTNERSHIPS, Page 3.
AGENCIES, Page 3.
FOR SALE, Pages 3, 8 and 98.
AUCTIONS, Page 98.
BUSINESSES and PREMISES (For Sale, etc.), Page 3.
MACHINERY, &c., WANTED, Page 8.
WORK WANTED, Page 8.

For Advertisement Rates see Page 527, Col. 1.

INDEX TO ADVERTISEMENTS, Page 97.

PUBLIC NOTICES

Port of Bristol.

THREE 9-TON STEAM CRANES FOR GRABBING.

The Docks Committee invite TENDERS for the CONSTRUCTION of THREE 9-TON STEAM CRANES for GRABBING. The contract includes the Erection of the Cranes on a Grab Hopper Dredger now in course of construction.

On and after Monday, the 3rd day of November, 1924, copies of the specification, &c., can be obtained from the undersigned on production of a receipt to the undersigned showing that a deposit of £5 has been paid to the BRISTOL DOCKS COMMITTEE, TO WHOM ALL CHEQUES MUST BE SENT AND MADE PAYABLE. The deposit will be returned to bona fide tenderers after the receipt of the Tender with all the prescribed documents and drawings.

The Tender must be enclosed in a sealed envelope, endorsed "Tender for Steam Cranes," and addressed to the General Manager and Secretary of the Bristol Docks Committee, 19, Queen-square, Bristol, and must be delivered to him, accompanied by all the prescribed documents and drawings, before 10 a.m. on Monday, the 1st December, 1924.

The Docks Committee do not bind themselves to accept the lowest or any Tender.

THOMAS A. PEACE,
Chief Engineer.

Chief Engineer's Office,
Avonmouth Dock, Bristol,
28th October, 1924. 7345

Rochester and Chatham Joint

SEWERAGE BOARD.
OUTFALL SEWER.
CONTRACT No. 1.

The Board is prepared to receive TENDERS for the CONSTRUCTION of about 6180 Yards Lineal of CONCRETE SEWER CULVERT, size 5ft. high by 3ft. 6in. wide, the whole length being in tunnel, together with deep manholes and other appurtenant works.

Plans may be seen and quantities and form of Tender obtained at the office of the Engineers Messrs. W. H. Radford and Son, Chartered Civil Engineers, Albion Chambers, King-street, Nottingham (and also at my office as under, from Ten to One each day of the week commencing November 3rd, when Messrs. Radford's assistant will be in attendance), on deposit of Five Guineas (cheque), which will be returned on receipt of a bona fide Tender and the return of the quantities.

The lowest or any Tender will not necessarily be accepted.

Sealed Tenders to be delivered to me at my office as under, on or before Tuesday, November 18th endorsed "Tunnel Sewer."

By order,
EDWARD B. LEE,
Clerk to the Board

Town Hall, Chatham,
13th October, 1924. 7237

State Electricity Commission

OF VICTORIA.
MELBOURNE, VICTORIA, AUSTRALIA.

TENDERS are hereby INVITED for the SUPPLY, DELIVERY, &c., of the following for the Yallourn Power Scheme.

Copies of Tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place, Strand,
London, W.C. 2.

SPECIFICATION NO. 24/114.—SWITCHGEAR AND ACCESSORIES.

CHARGE.—£2 2s. for the first three copies of Tender form, conditions of contract, specification and drawings complete. This charge will be returned on receipt of a bona fide Tender. A fourth copy and any further copies will be supplied for the sum of 10s. 6d. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £100 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders, on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than Noon, 20th December, 1924.

R. LIDDELOW,
Secretary.

7281

State Electricity Commission

OF VICTORIA.
Melbourne,
Victoria,
AUSTRALIA.

TENDERS are HEREBY INVITED for the SUPPLY, DELIVERY, &c., of the following for the Yallourn Power Scheme.

Copies of tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place,
Strand,
LONDON, W.C. 2.

SPECIFICATION No. 25/3.—VOLTAGE REGULATING APPARATUS.

CHARGE.—10s. for the first two copies of tender form, conditions of contract, and specification complete. This charge will be returned on receipt of a bona fide Tender. A third copy and any further copies will be supplied for the sum of 5s. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £5 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 12th January, 1925.

R. LIDDELOW,
Secretary.

7434

State Electricity Commission

OF VICTORIA.
Melbourne,
Victoria,
AUSTRALIA.

TENDERS are HEREBY INVITED for the SUPPLY, DELIVERY, &c., of the following for the Yallourn Power Scheme.

Copies of tender form and specification will be available upon application to—

Agent-General for Victoria,
Melbourne-place,
Strand,
LONDON, W.C. 2.

SPECIFICATION No. 25/1.—6600 V. TRANSFORMERS and SPARES.

CHARGE.—£1 1s. for the first three copies of tender form, conditions of contract and specification complete. This charge will be returned on receipt of a bona fide Tender. A fourth and any further copies will be supplied for the sum of 5s. each. This charge is not returnable.

PRELIMINARY DEPOSIT.—A preliminary deposit of £20 is to be lodged with Tender.

The specifications may be inspected at the above-mentioned office.

The Commission does not bind itself to accept the lowest or any Tender.

Tenders on prescribed form, properly endorsed and addressed, must be delivered to the undersigned in Melbourne not later than 5 p.m., 12th January, 1925.

R. LIDDELOW,
Secretary.

7435

Tenders are Invited for the

SUPPLY of a STEEL SCREW BARGE TUG, to be delivered at Dagenham Dock, Essex.

A copy of the specification will be sent upon receipt of Five Pounds, which will be refunded on receipt of a bona fide Tender.

The Tug must be built in a British yard of British materials, and a guarantee to that effect will be required.

Tenders to be delivered at Dagenham Dock, Essex, addressed SAMUEL WILLIAMS and SONS, Ltd., Engineers' Department, not later than December 1st, 1924. 7384

PUBLIC NOTICES

The Madras and Southern

MAHRATTA RAILWAY COMPANY, LTD.

The Directors are prepared to receive TENDERS for: FITTINGS for CAST IRON SLEEPER POTS for 90 lb. BULL-HEADED RAILS (B.S. SECTION, No. 90 R), comprising:

17,744 MILD STEEL TIE BARS.
35,488 WROUGHT IRON STANDARD COTTERS.
35,488 WROUGHT IRON STANDARD GIBS.

in accordance with the specification, which may be seen at the offices of the Company. The charge for the specification is One Guinea, which will not be returned.

Tenders must be sent in, addressed to the SECRETARY, not later than 1 p.m. on Tuesday, 25th November, 1924, and marked "Tender for Sleeper Fittings."

The Directors do not bind themselves to accept the lowest or any Tender.

Company's Offices:
25, Buckingham Palace-road,
Westminster, S.W. 1.
3rd November, 1924. 7419

PUBLIC HEALTH ACT, 1875.

Urban District of Stevenage,

HERTFORDSHIRE.

The Urban District Council of Stevenage, acting as the Sanitary Authority for the said District, are prepared to receive TENDERS for the RECONSTRUCTION of the STEVENAGE OUTFALL WORKS.

Particulars and specification may be obtained at the offices of the Consulting Engineers, Messrs. Howard Humphreys and Sons, 28, Victoria-street, Westminster, on and from Wednesday, the 12th of November, until Friday, the 21st of November, between the hours of 10 a.m. and 4 p.m., upon payment of a deposit of Three Guineas, which deposit will be returned upon receipt of a bona fide Tender which is not subsequently withdrawn by the contractor.

The successful tenderer will be required to execute a contract deed, the draft of which may be seen at the offices of the Consulting Engineers when the drawings are inspected.

Tenders must be on the official form, each Tender in a sealed envelope, marked "Tender for Outfall Works." Tenders must be accompanied by the general conditions and specifications as issued by the Consulting Engineers.

Each Tender must be signed in the handwriting of the tenderer or his authorised agent.

The Council does not bind itself to accept the lowest or any Tender.

Tenders must reach the undersigned by 9 a.m. on Wednesday, the 3rd of December, 1924.

Given under my hand the 1st day of November, 1924.

W. O. TIMES
Clerk to the Council.

Council Offices,
Stevenage, Hertfordshire. 7374

County Borough of Brighton.

WATERWORKS DEPARTMENT.
APPOINTMENT OF ENGINEERING ASSISTANT.

The Council invite APPLICATIONS for the APPOINTMENT of ENGINEERING ASSISTANT in the Waterworks Department at a salary of £400 per annum, the appointment to be for a period of three years in the first instance.

Applicants, who should have passed the Associate Membership Examination of the Institution of Civil Engineers, must have considerable experience in the design and lay-out of modern pumping plants, buildings, service reservoirs, and mains, and preference will be given to candidates who have had a mechanical training.

Applications, in the candidates' handwriting, stating age, training, experience, qualifications, and present occupation, together with copies of three recent testimonials, should be forwarded to the undersigned, endorsed "Engineering Assistant, Waterworks Department," not later than 22nd November, 1924.

Further information as to the appointment may be obtained from Mr. A. B. Cathcart, M. Inst. C.E., Waterworks Engineer, 12, Bond-street, Brighton.

JAS. H. ROTHWELL, C.B.E.,
Town Clerk.

Town Hall, Brighton,
4th November, 1924. 7421

CLERK OF WORKS.

The Southampton Borough

COUNCIL REQUIRE a TEMPORARY CLERK OF WORKS to supervise the Laying and Jointing of about 24 miles of 24in. and 18in. Trunk Water Mains.

Applications, endorsed "Clerk of Works," stating age, experience in the class of work required, together with copies of three recent testimonials, should be delivered at the WATERWORKS ENGINEER'S OFFICE, 21, Shirley-road, Southampton, by the 12th November, 1924. Salary £5 per week. 7427

SITUATIONS OPEN

IMPORTANT.

URGENTLY WANTED, the ADDRESS of DAVID RITCHELL FYFFE, Engineer.—Address, F9760, The Engineer Office. F9760 A

WILL ANYONE Having Knowledge of Mr. JOSEPH FOSTER, Mechanical Engineer, Draughtsman and Patent Agent, height 5ft. 10in., slim build, 70 years, resided 25 years Sandfield, E., during war second examiner munitions, Chiswick Buildings, Birmingham. CUMBERLIANS. F9768, The Engineer Office. F9768 A

WANTED by a Firm Proposing to Take Up Manufacture of Tea Machinery, a capable ENGINEER, thoroughly conversant with the trade.—Address, 7396, The Engineer Office. 7396 A

WANTED, GENERAL MANAGER for Bridge Building and Engineering Works in Yorkshire District; thorough Knowledge of Modern Works Practice, Designing, Estimating and Erection. Applicants should state previous experience, age and salary asked.—Address, 7356, The Engineer Office. 7356 A

CHEMICAL ENGINEER, with Sound Commercial training, REQUIRED for White Lead and Lead Oxide Works, run electrically.—By letter (only) stating age, experience and salary required, to ROWE BROS. and CO., Ltd., Pall Mall, Liverpool. 7401 A

ELECTRICAL ENGINEERING ASSISTANT REQUIRED, age 20-22, experienced in the design of all types of A.C. and D.C. Motors and Generators, Prime Movers, Transformers, Batteries, Electromagnets, Switchboards, and Wireless Transmitting Gear. State salary, age, experience, and references.—Address, 7452, The Engineer Office. 7452 A

ENGINEER MANAGER WANTED, British Colony (good climate and living conditions), for Electric Supply Undertaking (mainly water power). Must have first-rate commercial and managerial training, and good experience in all branches of operating. Age 28-35. Three years' agreement at least. Commencing salary, £700 per annum, with excellent prospects.—Address, giving full details of experience, references, &c., 7382, The Engineer Office. 7382 A

EXPERIENCED AIRCRAFT DRAUGHTSMAN REQUIRED; knowledge of Metal Construction desirable. State age, experience and salary required.—Box 776, T. B. Browne's Advertising Offices, 163, Queen Victoria-street, E.C. 4. 7398 A

INDIA.—STRUCTURAL ENGINEER. With Thorough workshop and drawing-office training, experienced in the preparation of Street Diagrams, Calculations, Designs, Estimates and Manufacture of Bridge and Structural Steel Work, REQUIRED to fill a senior position with a well-established British firm who have engineering works in India. Age 30 to 40. Commencing salary equivalent to £600 per annum.—Only those with suitable qualifications need apply to Box Z.7. 587, c/o Deacon's Advt. Agency, Leadenhall-street, London, E.C. 3. 7413 A

INSPECTOR of WORKS REQUIRED, Experienced in Tunnel Construction under heavy air pressure. State age and salary required and give full particulars of experience.—Address, 7446, The Engineer Office. 7446 A

SITUATIONS OPEN (continued)

JUNIOR ENGINEERING ASSISTANT REQUIRED, experienced in Road and Sewer Construction and Surveying.—Write, stating age, salary, experience, &c., Box 40, B. Anderson and Co., 14, King William-street, Strand, W.C. 2. 7441 A

REPRESENTATIVE REQUIRED for Sale of Special C.I. Pipe Fittings. Applicant must possess a thorough knowledge of the business and have connection which will bring immediate business. First-class opportunity to the right man. State full particulars and salary required. Only applicants in this special line need apply.—Address, 7440, The Engineer Office. 7440 A

SALES ENGINEER FOR MARINE OIL ENGINES.—WANTED, first-class MAN to INTRODUCE to Shipbuilders, &c., ENGINES by one of the largest firms of Oil Engine Manufacturers. State age, experience and salary required. No one, unless possessed of good sea-going knowledge of the requirements in marine internal combustion engines and with sales ability, need apply.—Address, 7405, The Engineer Office. 7405 A

SHIPYARD MANAGER WANTED to Take Entire Charge under general management; must have experience in Estimating, Designing and Construction of Merchant Vessels. State age, experience (in detail), and salary expected.—Address, "VESSELS," Wm. Porteous and Co., Advertising Agents, Glasgow. P9740 A

TRAFFIC INSPECTOR REQUIRED for Chinese Government Railways, to be fully qualified in all branches of traffic working and to have had ten years' experience on first-class English railway. Age not over 35. Three years' agreement.—Applications by letter only to "T. E.," c/o J. W. Vickers and Co., Ltd., 5, Nicholas-lane, E.C. 4, with fully detailed summary of career and copies of testimonials, if available, stating age, physical fitness, and whether married. 7412 A

WANTED, DRAUGHTSMAN, with Experience in Factory Plant Lay-outs and Power Transmission. State experience and salary required.—Address, 7407, The Engineer Office. 7407 A

WANTED IMMEDIATELY, ONE SENIOR DRAUGHTSMAN and TWO JUNIORS for Constructional Engineer's Office in S.W. London. Senior must be well up in Designing and thoroughly capable of Taking Complete Charge of Contracts. Juniors, age 18-24, must be good Detailers and capable of Taking Out Quantities for Estimating.—Address, stating age, experience, salary required, &c., P9762, The Engineer Office. P9762 A

WANTED IMMEDIATELY, TWO DRAUGHTS' MEN with Electric Lift experience, who would be capable of taking all own measurements from site and be responsible for putting work in hands in shops. None but good men need send particulars of age, experience, and salary required.—R. A. EVANS, Ltd., Prospect-road, Leicester. 7419 A

DRAUGHTSMAN REQUIRED, Having Recent experience in design of Vertical Two and Three-stage Compressors.—Early, stating age, career, and salary required, to REAVELL and CO., Ltd., Hanelagh Works, Ipswich. 7418 A

DRAUGHTSMAN (Young) REQUIRED, London, with good general engineering experience and able to do ordinary calculations. Knowledge of Hauling Gears and Winches helpful. State age, experience, and salary required.—Address, P9772, The Engineer Office. P9772 A

EXPERIENCED DRAUGHTSMAN REQUIRED for London Office, with good all-round experience in Designing all kinds of Cranes and Lifting Apparatus; must be quick and accurate.—Apply by letter to RANSOMES and RAPIER, Ltd., 32, Victoria-street, S.W. 1, giving full particulars of education, training, experience and salary required. 7408 A

HEAD DRAUGHTSMAN WANTED for Lancashire heavy general engineering; able modernise design. State special lines and indicate salary.—Address, 7383, The Engineer Office. 7383 A

JIG and TOOL DRAUGHTSMAN, 30 Miles from London; practical experience on this class of work essential.—Address, stating age, salary and experience, 7374, The Engineer Office. 7374 A

ONE or TWO FIRST-CLASS MECHANICAL DRAUGHTSMEN REQUIRED for country district in Yorkshire; must have good refinement, energy and initiative; preferably used to light work.—Address, 7391, The Engineer Office. 7391 A

REQUIRED, a Capable DRAUGHTSMAN, with wide experience in designing Machinery for Mixing and Separating Dry and Plastic Materials. A good knowledge of Hydraulic Machinery useful. State full experience, salary, and age.—Address, 7433, The Engineer Office. 7433 A

REQUIRED, the SERVICES of a DRAUGHTSMAN experienced in the design, arrangement and detail of Cane Sugar Factory Curing Plant. Only applications from men having expert knowledge of modern practice will be considered.—Address, giving fullest particulars, 7831, The Engineer Office. 7321 A

SHREWSBURY.—JIG and TOOL DRAUGHTSMAN WANTED. Must be first-class man with works and D.O. experience and with experience in designing jigs to give maximum efficiency. Only applicants with these qualifications need apply.—Address, 7455, The Engineer Office. 7455 A

TEMPORARY CIVIL ENGINEERING DRAUGHTSMAN REQUIRED, with practical experience in Harbour and Dock Work. Land Surveying, and the Design of Structures in Steel and Reinforced Concrete. Commencing salary 45s. per week plus Civil service bonus, giving present total of 70s. 3d. per week.

Also DRAUGHTSMAN, with knowledge of Building Construction, Land Surveying and Levelling, good mathematical training desirable. Commencing salary 24s. per week plus Civil service bonus, giving present total of 43s. 3d. per week. Preference will be given to ex-Service men.—Applications, giving ages, &c., accompanied by copies of recent testimonials, to be sent to the SUPERINTENDING CIVIL ENGINEER, H.M. Dockyard, Rosyth, Dunfermline, Fifeshire. 7379 A

MACHINE SHOP FOREMAN WANTED by Mill Engineers in North of England; energetic and capable man required.—Address, stating age, salary required and details of experience, P9786, The Engineer Office. P9786 A

SITUATIONS WANTED

ADVERTISER (28) with Some Sales Training, DESIRES CHANGE from Works to Sales Department; well-educated, college (engg.), and works experience; excellent references.—Address, P9770, The Engineer Office. P9770 B

BEGINNER, Some Knowledge, DESIRES SIT. in London Drawing-office; very keen; Lond. Matric.—Write, W. S., 91, Earl's Court-gardens, London. P9767 B

ENGINEER, A.M.I. Aut. E. (34), SEEKS Responsible POST. Fifteen years works, D.O., administrative exp. with well-known concerns specialising in automobile, electrical and hydraulic work; six years designer and assist. works manager to leading carburetter manufacturers. Excellent testimonials. Disengaged.—E. K., 57, Woodlands-crescent, S.W. (1). P9766 B

ENGINEER (26), Good Education and Address, Pupil with well-known firm of machine tool makers, recently returned from contract abroad, DESIRES POSITION on Works or Sales Side; in England preferred.—Address, P9757, The Engineer Office. P9757 B

ENGINEER-SECRETARY (26), Sound Commercial training, preparing Final Honours Engineering Degree, evenings, DESIRES POSITION Departmental Assistant or similar.—Address, P9763, The Engineer Office P9763 B

SITUATIONS WANTED (continued)

ENGINEERS' PUBLICITY MANAGER SEEKS APPOINTMENT. Advertising, catalogue compiling, press notices, brochures, high-class illustrations. Expert technical photographer. Practical knowledge of hydraulic and electrical machinery (including electro-deposition of metals), printing machinery, scientific apparatus. Correspondence invited from engineers and manufacturers.—Address, 7437, The Engineer Office. 7437 B

ESTIMATOR DESIRES POST with Prospects; 9 years D.O. and estimating, constructional work, W.T. boilers and auxiliaries; used to handling complete boiler-house schemes; good technical knowledge.—Address, P9785, The Engineer Office. P9785 B

ESTIMATING ENGINEER, 20 Years' Experience, general pumping machinery for irrigation, waterworks, &c., all types and drives, REQUIRES SITUATION IMMEDIATELY.—Further particulars from "X.," 11, Woodlands-road, Barnes Common, S.W. 13. P9784 B

MANUFACTURING EXECUTIVE, with Broad mechanical and engineering experience, SEEKS CONNECTION with PROGRESSIVE CONCERN; capable organiser, energetic and resourceful, thoroughly conversant with modern cost, planning, routing, standardisation and production control methods. Record and character will stand the closest scrutiny.—Address, P9781, The Engineer. P9781 B

REPETITION WORK.—ADVERTISER (25) SEEKS RESPONSIBLE POSITION; 10 years' exp. all depts., small rep. work; good technical education.—F. GEUBERT, Stonemarsh, Barton-on-Humber. P9764 B

RESIDENT ENGINEER or CONTRACTOR'S AGENT, POSITION WANTED as; roads, bridges, docks, railways.—Address, 7471, The Engineer Office. 7471 B

TOOL ROOM SUPERINTENDENT and DESIGNING ENGINEER for Large Modern Engineering concern of first rank. DESIRES CHANGE OF EMPLOYMENT. Disciplinarian, technically trained, rapid draughtsman, with exceptionally clear vision and understanding of machine shop organisation, experienced in clearing apparatus of unnecessary machining, and changing design to a straightforward manufacturing proposition. Nine years present employers, controlling large tool room organisation, now desires responsible position with sound progressive private engineering concern. Age 35, married. Replies will be acknowledged and treated as confidential.—Address, P9776, The Engineer Office. P9776 B

WATERWORKS.—WATERWORKS ENGINEER, experienced in design, construction, and maintenance, REQUIRES POST or would JOIN CONSULTING ENGINEER.—Address, P9775, The Engineer Office. P9775 B

YOUNG ENGINEER (22), 4 Years D.O., Steam, technical training, 2 years University, REQUIRES POST with civil engineer or railway, steam, &c.; London district.—Address, P9780, The Engineer Office. P9780 B

YOUNG ENGINEER, &c., DESIRES CHANGE. A.M.I.E.E., A.M.I. Mech. E. (Chartered Civil Engineer), passed final exam. reading design, Law, City and Guilds, possesses a thorough knowledge foundry work and general engineering. Will specialise in any branch, either civil, electrical or mechanical. Good knowledge of works economics, keen, not afraid of work. Progressive berth. Used to designing, estimating, costs, inspections, and works administration.

Moderate salary for good opening.
Address, 7464, The Engineer Office. 7464 B

FOREMAN BOILERMAKER (43) DESIRES POST; experience in marine, water-tube, vertical and land boilers, also iron and steel works and some own plant construction and maintenance.—Address, P9782, The Engineer Office. P9782 B

TOOL FITTER, 23 Years' Experience with Firearms 32mm.; dies, bending jigs, &c., for mass production; owing to age and deafness will take position where not heard.—Address, P9755, The Engineer Office. P9755 B

PARTNERSHIPS

IF YOU ARE SEEKING
A PARTNER or PARTNERSHIP
or wish to buy or sell a
BUSINESS or WORKS
Write:
WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
London, E.C. 4.
Established over 70 years.

WANTED by an Old-established Firm of CRANE BUILDERS in the North of England, a First-class MAN with capital of not less than £5000, to Take Full Charge. Must have experience of Cranes and Lifting Machinery, be able to estimate costs, and have ability to secure orders. The capital would be put into the business, control salary and profits fixed by agreement. Applications treated confidentially.—Address, 7347, The Engineer Office. 7347 C

WANTED, PARTNER to Join Consulting Engineer, Steel Work and R. Concrete Specialist with offices in London; capital not so much required as ability to obtain work.—Address, P9773, The Engineer Office. P9773 C

PARTNERSHIPS and ACTIVE DIRECTORSHIPS WANTED in Mechanical, Constructional, Electrical Engineers, &c., for Clients with technical experience and capital from £1000 to £20,000.—GILBERT and PRATT, 18, Walbrook, London, E.C. 4. Ex C

AGENCIES

AIR COMPRESSORS.—Old-established and Well known Makers OPEN to APPOINT HAVE MAN or FIRM having good connection as AGENT for Yorkshire.—Address, P7875, The Engineer Office. P7875 D

ENGINEERING AGENCIES WANTED by Established Firm Engineers, with offices and showrooms, working S.W. England and South Wales.—Address, P9746, The Engineer Office. P9746 D

LIVE, Essex, Firm ENGINEER TRAVELLERS, calling works, collieries and power users, covering ground by car, well known to heads and buyers, DESIRES SOLE AGENCY first-class Manufacturers of Steam Plant and/or Accessories, for South Wales and Monmouthshire. Efficiency and reliability first consideration. Diligent and intelligent service offered.—Address first instance, 7408, The Engineer Office. 7408 D

LIVE, Essex ENGINEER TRAVELLER, calling on works, collieries, power users, garages, &c., DESIRES SOLE AGENCY for Glamorgan and Monmouthshire; office centrally situated, telephone, well known to trade and buyers; wages and commission basis.—Address, P9769, The Engineer Office. P9769 D

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Two New P. and O. Steamers.

With the launch last Friday of its two new steamers, Cathay and Comorin, the P. and O. Company has come a good step nearer replacing the heavy loss of tonnage which its fleet suffered during the war as a result of enemy action. The vessels are noteworthy, not only because they were launched almost at the same instant—from the West and Clydeholm yards respectively of their builders, Barclay, Curle and Co., Limited, Glasgow—but because they are propelled, not by turbines, but by quadruple-expansion balanced engines. This departure from what is now in vessels of their class almost standard practice is clearly of some significance. The vessels—and a sister ship, the Chitral, now being built on the Clyde by Alexander Stephen and Son—are each of 15,000 tons gross register and, it is claimed, provide passenger accommodation in a style never before attempted on board a ship. Only 200 first-class and 100 second-class passengers will be carried instead of the 600 or so for whom a few years ago accommodation would have been found within the space available. The passenger accommodation is distributed over three decks and comprises 150 single berth and 75 double-berth cabins. The cabins, it will be gathered, are therefore exceptionally large. The public rooms are on an equally generous scale. The vessels measure 545ft. in length, 70ft. in breadth, and 46ft. in depth. In addition to the passenger accommodation they will be fitted to carry 600,000 cubic feet of cargo, half of which space will be insulated for refrigerated cargo. The 13,000 indicated horse-power engines will drive twin screws and will give the vessels designed service speeds of 16 knots. Steam will be raised at 220 lb. pressure in seven cylindrical boilers fitted to burn oil fuel under forced draught.

British Airships.

Speaking at a luncheon at Sheffield on Wednesday, Sir Trevor Dawson, vice-chairman of Vickers Limited, stated that his firm had signed a contract for the construction of an airship of 5,000,000 cubic feet capacity, or more than twice the size of the German-American Zeppelin ZR 3, which recently crossed the Atlantic. The two sheds at Howden, Yorkshire, used for airship purposes during the war, had been secured by Messrs. Vickers and would be employed for assembling the parts of the new vessel. The commercial success of airships, Sir Trevor said, would depend very much upon obtaining a satisfactory engine, but it was anticipated that sooner or later it would be possible to perform the Transatlantic journey in less than two days. It is obvious that the airship to which Sir Trevor Dawson was referring is that which the Burney-Vickers-Shell-Mex group was to be offered by the late Government the chance of contracting for and of subsequently purchasing for commercial operation. Another contract connected with the late Government's airship scheme has also just been placed, namely, one for the extension of the Cardington airship shed near Bedford from a length of 700ft. to a length of 812ft. The height is to be increased to 156ft., while the width is to remain at 180ft. This increase of dimensions is required to accommodate the new 5,000,000 cubic feet Government airships, the length of which, it is said, will be about 760ft. and the diameter about 110ft.

Electrical Precipitation.

During the course of a recent lecture before the Institute of Physics at the headquarters of the Institution of Electrical Engineers, Sir Oliver Lodge discussed the control of the atmosphere and rainfall. He urged experimenters to set to work to see what could be done to obtain rain. Large parts of the world, he said, suffered from drought, and although clouds formed over those areas, they did not precipitate. Sooner or later a clue would be found that would lead to the right track, and he was sure that some future generation would witness the control of rainfall. Sir Oliver described the wonderful results obtained by the electrical precipitation of dust from gases, and explained that as much as 20 tons per day of valuable dust containing potash were being obtained from a single blast-furnace.

The National Association of Water Users.

As a reply to the activities of the British Waterworks Association in its renewed endeavours to secure for its members statutory control over water consumers' choice of fittings, &c., a body known as the National Association of Water Users was formed a year ago among water pipe and fittings manufacturers, builders' merchants, architects, hot water engineers and others. It was contended that the insistence of certain water authorities upon all fittings, &c., being tested, approved and stamped before a supply was given was not only *ultra vires*, but was impeding the production and use of improved appliances. The Waterworks Association failed in October last year to secure the Ministry of Health's sanction to a proposed specification for standard pipes and fittings, but that the necessity for a consumers' association was thereby rendered unnecessary is contradicted by the report just issued covering the first year's work of the National Association of Water Users. A general change is recorded in the attitude of water authorities towards fittings manufacturers and consumers. In the case of several authorities complaints were received that objection was being made to certain fittings and that a supply was being refused until the fittings had been tested and stamped. In some cases the intervention of the Association led to the water being turned on without further trouble. In others the authorities' demands were ignored or combated with successful results. In one instance in which the demand for testing and stamping had been expressed in writing, the water authority expressed regret for the action of its representative.

A New Type of Sailing Ship.

Certain incomplete and unsatisfactory information has been received from Germany this week regarding the trials of a new invention designed for the wind propulsion of ships and as an alternative both to sails and to mechanical power. We would have ignored the reports but for the facts that the invention is ascribed to Herr Anton Flettner, the inventor of the Flettner rudder, that the preliminary experiments on the scheme were carried out, so it is said, at the Goettingen Aerodynamic Laboratory, and that both Krupps and the Hamburg-America Line are stated to be connected with or interested in it. The reports are therefore well sponsored. It is not quite clear what the principle of the invention is. We infer, however, that the vessel to which it has been applied is equipped, in place of masts, with towers 60ft. high carrying some form of wind turbine 10ft. or so in diameter. The rotors turn at about 100 revolutions per minute—that is, presumably, if there is wind enough to drive them—and are coupled to an electric generator supplying current to motors on the propeller shafts. So ambiguous and incomplete are the accounts of the invention that we cannot feel sure that we have surmised its nature correctly. It is just possible that the rotors do not drive the electrical equipment, but are themselves driven, so that the invention would consist in replacing the water screws by a form of air fan. It is said that the vessel fitted with the new invention can outsail any comparable steamer or motor ship, that it possesses great manœuvring ability, can sail nearer to the wind than an ordinary sailing vessel, and that the running labour charges are greatly reduced. In neither form would the principle of the invention be new. We await with interest some additional details concerning its technical nature.

New Wave Lengths for American Ships.

The question of adopting new wave lengths for ships' wireless, with a view to avoiding interference with broadcasting was recently considered at the National Radio Conference held at Washington. Originally, it was suggested that the use of spark transmitters should be abolished, but it was explained by Mr. George S. Davis, general manager of the United Fruit Company, who represented the American Steamship Owners' Association, that this procedure would involve very great expense. The new plan is to permit the use of both spark and continuous wave equipments. A wave length of 600 m. is to be used for calling and distress purposes only, and there are to be four working wave lengths between 630 m. and 1000 m. A wave length of 800 m. is to be employed for the "wireless compass," whilst the wireless beacons are to work at 1000 m. For the exclusive use of ships employing continuous wave equipments, the calling and traffic wave lengths suggested are between 1900 m. and 2500 m. Hitherto, American ships have been confined by law to wave lengths of 300 m., 600 m. and 1800 m. But since the advent of broadcasting the need for a change has been badly felt. The recommendations of the Wave Length Allocation and Marine Committee, Mr. Davis states, were adopted by the Conference as a whole, and will undoubtedly be put into effect by the Secretary of Commerce. The recommendations are in many respects contrary to the international regulations and to the United States laws, but recognising that those laws and regulations are obsolete, the Department of Commerce will undoubtedly be guided by the recommendations of the Conference.

Australian Locomotives.

It is announced that the Agent-General for Queensland has been instructed by his Government to invite tenders, returnable on December 2nd, for the supply of twenty-two locomotives. The report published in the Journal for October 24th to the effect that the New South Wales Government had awarded a contract for thirty-five locomotives to the Clyde Engineering Company of Sydney, at a total cost of £391,000 in face of a tender from the North British Locomotive Company for £351,000—including tariff duty of £72,000—has been confirmed. Indeed, it has been openly stated in the New South Wales Assembly by Mr. R. T. Ball, the Minister for Works and Railways, that the Clyde Engineering Company was informed by the Railway Commissioners that it could have the contract if it reduced its original price. It did so, to the extent of bringing it some 10 per cent. above the lowest British figure, and secured the order. The Commissioners' action in calling for overseas tenders was defended by Mr. Ball on the ground that by securing competitive tenders they could bring the prices down. There is thus ample room for the belief that the New South Wales and other Australian Governments invite British tenders solely as a convenience and to safeguard themselves against excessive local tenders, and without any intention from the start of placing the work in this country. It will be interesting to see what action our locomotive builders take over the Queensland Government's invitation to tender. It may here be added that we have information to the effect that in all Australian municipal and Commonwealth contracts, there is an enforced preference for Australian manufactures under which the order must be given to an Australian firm, if its price is not more than 10 per cent. above the foreign price, the 10 per cent. being reckoned on the foreign firm's c.i.f. price plus tariff duty.

American Fleet Manœuvres.

The United States naval manœuvres to be held in the coming year will be on a very extensive scale, according to particulars issued at Washington. On February 15th the ships of the Atlantic division are to join up with the Pacific Fleet at San Pedro, and the combined force will then carry out tactical exercises for a period of two months. On April 15th the entire fleet is to sail for Honolulu, in the Hawaiian Islands, which will serve as its main base during the manœuvres proper, which are expected to last nearly six weeks. They have evidently been planned with a view to testing the utility of the Hawaiian naval station at Pearl Harbour as a self-contained base for a very large fleet, such as would be concentrated there at the first threat of war in the Pacific. American naval officers have long contended that the docking, repair and magazine facilities at Pearl Harbour are inadequate for the requirements of a great fleet, and the forthcoming manœuvres may have been arranged to furnish an object-lesson in this respect. They will, at the same time, enable problems of steaming endurance, transport and supply to be studied under realistic conditions, for Pearl Harbour is 2100 miles distant from the American mainland. Early in June the Atlantic ships will return to their normal station, and on July 1st the Pacific battle fleet is to leave Honolulu for a voyage to Australia and New Zealand, by way of Samoa. Visits will be paid to Sydney, Melbourne, Auckland and Wellington. The fleet is due to return to Honolulu on September 10th. This is the first occasion on which extensive naval manœuvres have taken place from an advanced base in the Pacific, and valuable lessons are expected to result from them.

The Lytham Railway Disaster.

It is to the credit of British railway engineers that, excepting the Little Salkeld accident in January, 1918, which might be regarded as an act of God, there has not been a derailment in which passengers have been killed since that at Weedon in August, 1915, over nine years ago. This excellent record has, however, now been broken by the serious disaster on Monday evening last, near Lytham on the Preston and Wyre section of the London, Midland and Scottish Railway. By the derailment of the 4.40 p.m. express from Liverpool to Blackpool (Central), the driver and twelve passengers were killed. This makes the record for fatalities in one accident the worst since Abermule in January, 1921, and the year's record the worst since 1915. At the time of writing, the cause of the accident has not officially been revealed, but it will apparently become clear when the Ministry of Transport inquiry is held.

Shipbuilding Profits.

The unfavourable situation of the shipbuilding industry of this country, which, it is earnestly hoped, it is now emerging from, is amply illustrated by the statement of accounts of the Fairfield Shipbuilding and Engineering Company for the year ended on June 30th, 1924. No doubt, this large and important undertaking is to be congratulated on being able to show a profit at all, for other concerns of similar standing have been unable to do so. But when we learn that the profits, after allowing for expenses and taxation, amounted only to £149, we are compelled considerably to temper our congratulations with sympathy. For the previous year the company's profits were £59,105. A balance brought in of £130,836 has been reduced to £92,235 by payment of debenture interest and preference dividend. In the previous year depreciation was allowed for before the profit was struck, but this year no further provision has been made for depreciation. On the company's ordinary capital of £250,000 no dividend has been paid since 1921–22, when 5 per cent. was distributed.

The Humberarm Hydro-electric Development in Newfoundland.

A LARGE and important hydro-electric development scheme is in course of being carried out on the Humber River in Newfoundland by the Newfoundland Power and Paper Company, Limited. The water from which the power is to be derived will be obtained from what is known as Grand Lake, which lies between St. Johns and Port aux Basques, being some 350 miles from the former and 170 miles from the latter. The level of the lake will, when the plant is in operation, vary between 377ft. and 370ft. above sea level, and the level of Deer Lake, into which the water will be discharged from the turbines, may vary between 115ft. and 105ft. above sea level, while the head actually available at the power-house will vary, ordinarily, between 250ft. and 265ft.

The paper mills of the company are being erected on an enlargement of the Lower Humber River, known as the Humber Arm, at a point some 32 miles downstream from the site chosen for the Power House. The mill is designed to produce 120,000 tons of newsprint per annum, and not only is its mechanical equipment to be entirely driven by electric power, but the steam required in its various processes is to be partly produced by means of electrical energy. Very nearly the whole of the necessary plant is being supplied from this country, Sir W. G. Armstrong, Whitworth and Co., Limited, being the contractors in chief. Certain things, however, will be of Canadian manufacture.

The map—Fig. 1—will serve to show the relative positions of the Grand Lake, Deer Lake, and the Power House, and of the paper mills at Corner Brook Town on the Humber Arm, while Fig. 2 shows the arrangement of the dam, the intake, the canals, the pipe line and the Power House. The original surface area of Grand Lake was 130 square miles and its catchment area—some 1650 square miles—is such that it is capable of discharging, as an average throughout the year, a daily volume of 5000 cubic feet per second (cusecs) at an elevation of 346ft. The discharge was originally by way of the Junction Brook into the Upper Humber River and thence into Deer Lake, the mean level of which is +110ft. There was therefore an average natural difference in level between the two lakes of 236ft. By constructing a dam across the Junction Brook, however, the level of the Grand Lake has been raised so that its top water level will vary between +370ft. and +377ft., as has been already said, and the effect of raising its level has been to increase the surface from 130 to 150 square miles and to provide a storage of 30,000,000,000 cubic feet of water, which, it is estimated, will ensure a continuous discharge of 4000 cusecs—a volume which, with an effective head of 250ft., represents a theoretical effective horse-power of 113,000. Allowing an overall efficiency of 80 per cent., that would mean something over 90,000 continuous horse-power. Actually, it is proposed to install in the Power House seven hydro-electric generating units, each of 14,000 horse-power. The seasonable variations in the discharge from the lake are, of course, very considerable, and though the daily flow may average some 5000 cusecs taken over the year, there are times when the volume coming down is as much as from 30,000 to 40,000 cusecs—the latter representing a daily flow of over 21,500,000,000 gallons, and, conversely, times when there is much less than 5000 cusecs coming down. It was, of course, because of these considerable fluctuations that it was necessary to impound such a large volume of water as 30,000,000,000 cubic feet, which represents nearly eighty-seven days' continuous flow at the rate of 4000 cubic feet per second. There is, therefore, provision for a considerable period of drought.

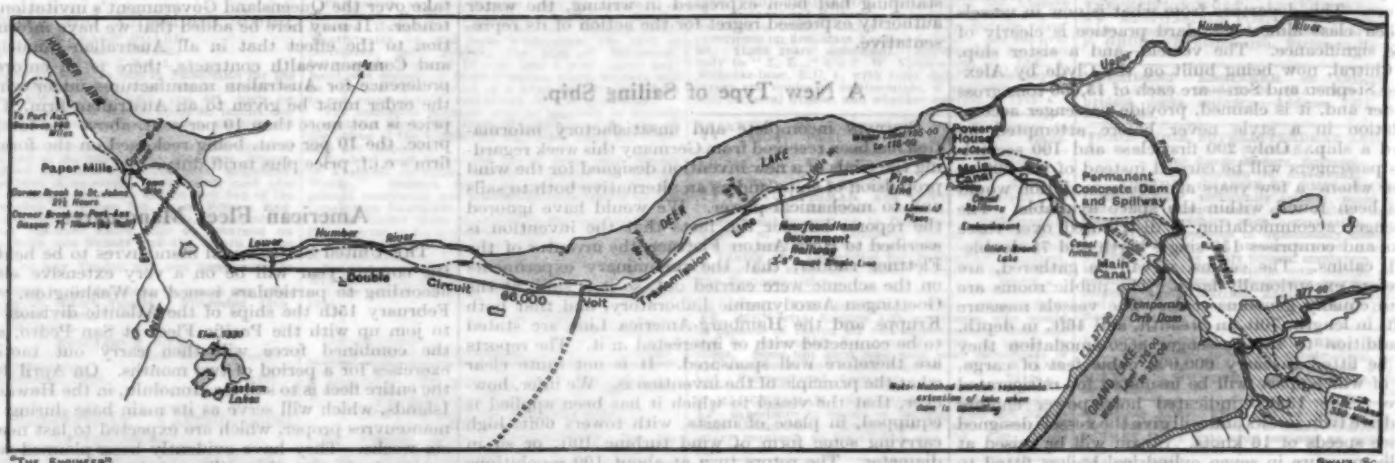


FIG. 1—PLAN OF HUMBERARM HYDRO-ELECTRIC DEVELOPMENT SCHEME

The dam by which the level of the lake is raised is some 1000ft. in length and 75ft. high from foundation level. The site on which it was built is shown in Fig. 14, page 526, while a view of it is given in Fig. 15 and another view of it in a later stage of construction in Fig. 3. It is of reinforced concrete and of the hollow type, and it was built with the aid of a couple of overhead ropeways. In order to make its construction possible a temporary crib dam was built a little way upstream and the discharge from the lake diverted. The crib dam will, of course, be removed when the construction of the dam is completed. As will be noticed from Figs. 1 and 2, the Reid Newfoundland Railway, joining St. Johns with Port aux Basques, crossed the Junction Brook close to the site of the temporary crib dam. In order to save the expense of lengthening the old bridge or making a new one it was arranged to divert the line so that it passes over the new dam. For regulating the discharge of water from the lake and maintaining the surface at the desired level there has been provided a spillway furnished with eighteen openings, each 15ft. wide, which are controlled by electrically operated sluices and are designed to pass a flood of 26,000 cubic feet per second, which will be led away down the Junction Brook and Upper Humber River into Deer Lake. The dam will probably be completed by the time this description is published. At any rate, our latest advices are that it was hoped to finish it before the Autumn.

The water from the Grand Lake is led towards the Power House by means of a canal some 8 miles in length, which is divided into two separate portions—the Eastern Cut and the Western Cut—by what has been called the Glide Brook Lake, an artificial sheet of water which has been created in a depression in the ground by the construction of two earth embankments known as Long Bank and Deep Bank, respectively—see Fig. 2 and Fig. 17, page 526. Long Bank, of which a view showing the method of construction is given in Fig. 4, has a length of no less than 4000ft. and its maximum height is 35ft. Its crest level stands at an elevation of + 372. Deep Bank is only 950ft. long, but its maximum height is 75ft. The longer

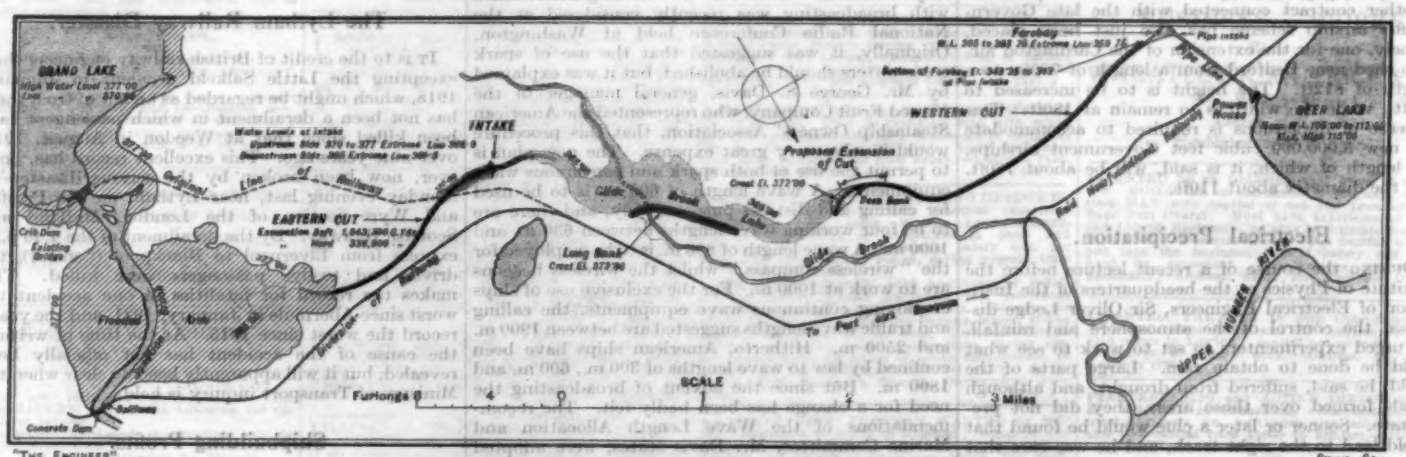


FIG. 2—ARRANGEMENT OF DAM, INTAKE, CANALS AND PIPE LINE

embankment required 183,000 cubic yards of consolidated fill, and the shorter 115,630 cubic yards, the material in each case being obtained from excavation from the canal. By this expedient of taking advantage of a depression in the ground and forming Glide Brook Lake, the total length of excavation for the canal was shortened by as much as 2¼ miles. Some idea of what that means may be gathered from the fact that the Eastern Cut, as it stands, necessitated 1,643,100 cubic yards of excavation in soft and 336,900 cubic yards of excavation in hard material, while the Western Cut required 1,374,270 cubic yards of excavation in soft and 241,688 cubic yards of excavation in hard material. Incidentally it may be explained that, in addition, (*a*) 150,000 cubic yards of sand had to be removed from the lower bank of the Western Cut, where it was found to be porous, and 124,000 yards of consolidated fill put into render the bank water-tight; and (*b*) 138,513 cubic yards of material were required for banking the sides of this cut. A view of the downstream end of the Eastern Cut of the canal is shown in Fig. 16, page 526.

The inlet to the eastern section of the canal is 2 miles up from the main dam, and the flow is regulated at the intake works which are situated near the downstream end of the section. The intake works comprise five sluice gates, each 22ft. wide by 15ft. high, which are operated by two bronze screws which, in their turn, are actuated by an electric motor through gearing. Limiting switches of the auto-self-resetting, shunt type are provided, and there is independent hand-operating gear for use in case of necessity. The water levels at the intake vary on the upstream side from + 377ft. to + 370ft., or in extreme cases down to + 366.5ft., while on the down-

stream side the level is + 365ft., or in extreme cases as low as + 361.5ft.

The forebay is at the downstream end of the

FIG. 3—CONCRETE DAM ON JUNCTION BROOK

Western Cut. It is furnished with seven sluices, each 12ft. square, which control the flow of water to the

FIG. 4—CONSTRUCTING PERMANENT LONG BANK

pipe line. The sluice gates are of steel and they are furnished with rollers and rubbing strips to keep them aligned in the guide frames. They are each operated by a single screw which is actuated by an electric motor. There is, in addition, portable gear for operating the sluices by hand. For leading the water from the forebay to the Power House there are seven pipe lines—with space for two more—each of which is furnished with an automatic trip gear that is designed to come into action, and close the particular sluice in question, if the velocity exceeds a certain limit, as for instance in the event of a pipe bursting. An overhanging wall prevents ice from finding its way into the penstocks, and there is a steel grid to catch floating *débris*. In addition, there is a chute formed of steel plates and angles, through which logs coming down the canal are diverted into Deer Lake.

The water level in the forebay will ordinarily vary from + 365ft. to + 363.25ft. with, exceptionally, a low limit of + 359.75ft.

Each pipe line is 4000ft. long. The top portions for a length of 2500ft. and down to a head of 170ft. are made of wood stave pipes reinforced by steel bands. The inside diameter of these wooden pipes is 9ft. 6in. and the maximum pressure due to head of water at the lower end is nearly 74 lb. per square inch. No less than 150,000 cubic feet of timber and 2000 tons of steel were used in the construction of these pipes. The lower lengths of the pipe lines are of riveted steel—made in the Walker Shipyard of Messrs. Armstrong's, the diameter varying from 9ft. 6in. at the top to 8ft. 6in. at the bottom. The weight of steel in them reaches a total of about 4000 tons.

The Power House, which, as explained above, is

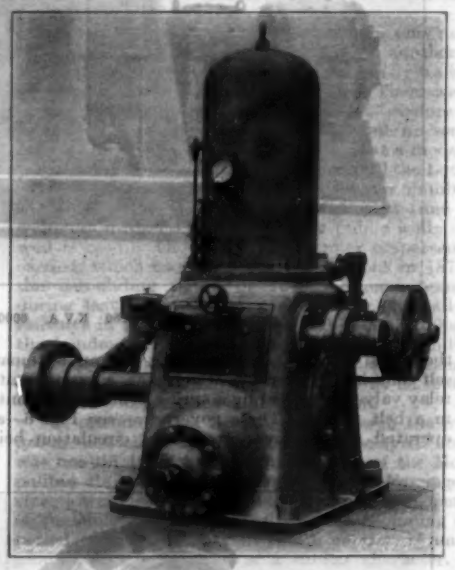


FIG. 6—OIL-PRESSURE TURBINE GOVERNOR

being built on the shore of Deer Lake, is no less than 387ft. long by 60ft. wide. It is to contain seven main turbo-generators, each designed for an output of 10,250 kilovolt-ampères at 95 per cent. power factor, and each having its own direct-coupled exciter. The turbines, which are of the horizontal shaft spiral-cased Francis type, are each to be capable of developing 14,000 brake horse-power under a net head of 250ft. when running at 375 revolutions per minute. Views of one of the turbines in course of erection in the makers' works are given in Fig. 5. Tests carried out by Messrs. Armstrong's with a reduced scale model are said to have indicated that these turbines should have an efficiency of at least 91 per cent. The shafts of all the turbines and alternators are to be arranged in line along the length of the house. The spiral casing of the turbine is made up of three steel castings which together weigh 25 tons. The runner, which is 4ft. 9in. in diameter, consists of a cast steel

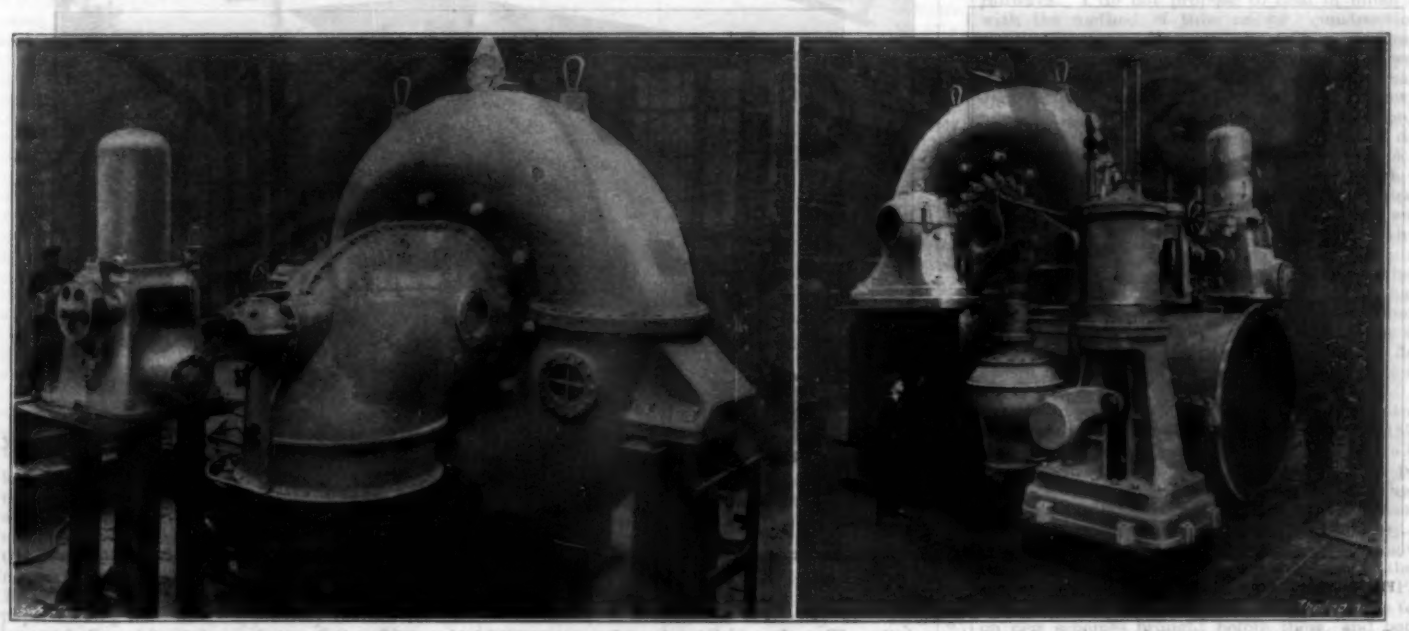


FIG. 5—14,000 H.P. TURBINE IN MAKER'S SHOP

hub and discharge ring with mild steel buckets cast into them. The shaft is carried by two bearings, one of which is of the pedestal type and has a spherically seated liner, while the other, which is mounted on a

bracket on the turbine discharge band, is furnished with a Michell thrust bearing to take any unbalanced hydraulic thrust. The distributor consists of the usual cast steel pivot vanes with external connecting gear. A cast steel butterfly valve, which is hydraulically operated, is flanged to the horizontal section of the spiral casing. Each turbine has an automatic self-contained governor, which has a compensated relay valve controlled by a spring pendulum mounted in a belt pulley. These governors—see Fig. 6—are operated by oil pressure, the oil circulation being maintained by means of a rotary gear pump. A pressure accumulator is mounted on the top of the governor case, the latter having cast integrally with it the twin servo-motor cylinders which actuate the governor shaft, to which are connected the governor-operated pressure relief valves arranged on either side of the turbine casing.

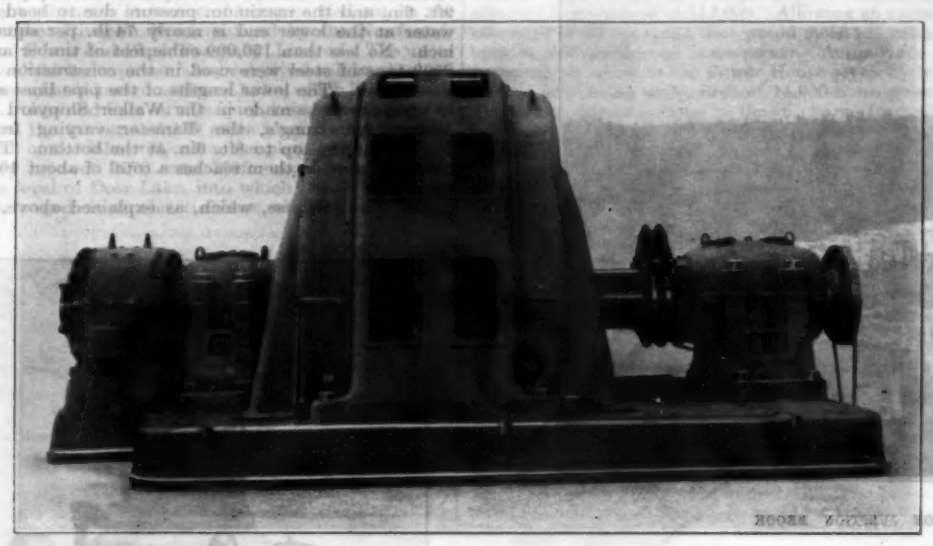


FIG. 7—10,250 K.V.A. 6600 VOLT, 3-PHASE ALTERNATOR

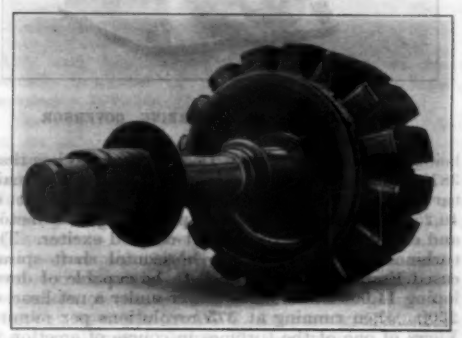


FIG. 8—ROTOR OF 10,250 K.V.A. ALTERNATOR

For satisfactory governing it was found to be necessary for the turbine unit to have a heavy fly-wheel. The total fly-wheel effect estimated to be required was about three times that which could be provided by the generator runner. Accordingly a fly-wheel, 12ft. in diameter and weighing 20 tons, has been incorporated in the design, the fly-wheel being inserted between the coupling flanges on the ends of the turbine and generator shafts. This heavy fly-wheel was necessitated by the severe conditions for automatic speed regulation, resulting from a pipe line 4000ft. long and a head of only 250ft. to 260ft. The weight of the fly-wheel might have been made less than it actually has been made had it been possible to provide a surge tank, but the configuration of the ground was such that a surge tank could not be arranged sufficiently near to the power to do away entirely with the necessity for a separate fly-wheel. The turbines, including their butterfly valves, automatic governors, and pressure relief valves were manufactured at the Elswick Works of Messrs. Armstrong, Whitworth.

The electrical equipment of the Power House, in addition to the main generators, will include three-phase step-up transformers, 66,000 volt switchgear, and a certain amount of auxiliary machinery and switchgear for giving a local power supply at 6000 volts. The generators and the switchgear are being supplied by the British Thomson-Houston Company, Limited, of Rugby, and the transformers by the Canadian General Electric Company, of Toronto. One of the main generators is illustrated in Fig. 7, while its rotor, with the exciter armature, are shown in Fig. 8. It will be observed that the rotor has sixteen poles. Three-phase 50-cycle current is generated at 6000 volts, and for transmission to the paper mill that pressure is raised to 66,000 volts by means of water-cooled three-phase transformers, each transformer being of the same rating as the alternators and one transformer being connected to each machine. The type of isolating switch employed is shown in Fig. 9, while a view of one of the oil circuit breakers is given in Fig. 11. The latter are of the "explosion pot" type, and are claimed to have a very high rupturing capacity. The generation of gases when the circuit is interrupted is confined to the inside of the pot, the expansion of these gases causing a rapid interruption of the circuit, while the outer tank is relieved of any excessive pressure. It will be seen in the illustration that one oil tank has been lowered so as to show the contact rods and the explosion pots.

Four separate circuits are employed to transmit the energy from the Power House over the 32 miles to the Paper Mill. They are carried on two lines of lattice steel towers set about 400ft. apart. The conductors, which will be supported on pin insulators, will be steel-cored aluminium cables having a cross sectional area of 266,800 circular mils and the spans vary from 350ft. to 400ft. At the Mill the conductors are led to duplicate 66,000-volt bus-bars, which are controlled by circuit breakers and isolating switches, of the same type and make as those at the Power House. From the main bus-bars the energy is supplied to three secondary bus-bars through six single-phase 5500 kVA water-cooled transformers, made by the Canadian General Electric Company, which deliver current at 2200 volts to bus-bars from which the heavy pulp grinders and paper machine synchronous motors are fed. Two of these motors are being supplied by Crompton and Co., Limited, of Chelmsford, and seven by the British Thomson-Houston Company. From the same bus-bars, power will also be supplied to several large-sized induction motors. There are also twelve single-phase 4000 kVA transformers for supplying 4400-volt current to the boilers in the Mill and three single-phase 2000 kVA transformers for supplying current to 550-volt bus-bars and feeders. Another set of bus-bars will operate at 5500 volts, and will be used to supply power to small motors and general apparatus in the Mill. An auxiliary circuit for lighting and for operating portable units is supplied through motor generator sets from the 550-volt bus-bars. Features of the installation will be separate exciter

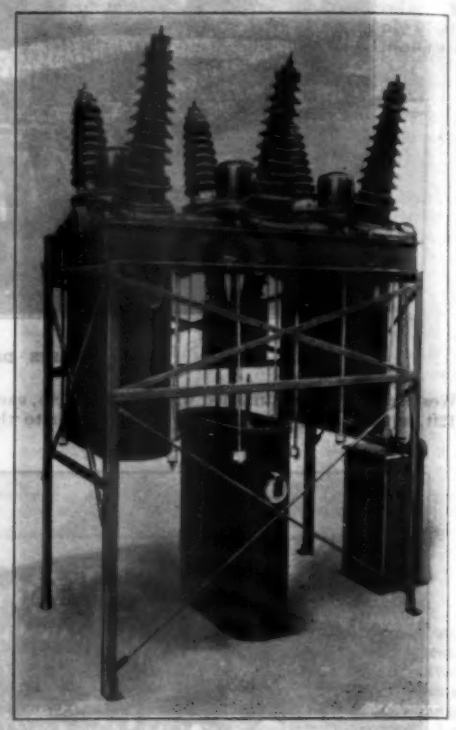


FIG. 11—66,000 VOLT 3-PHASE CIRCUIT BREAKER

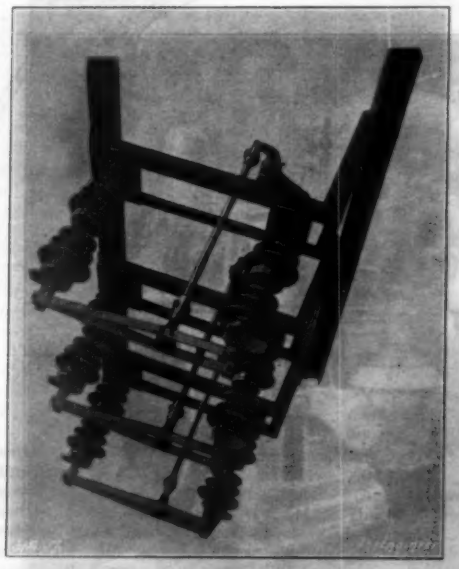


FIG. 9—66,000 VOLT 3-PHASE ISOLATING SWITCH

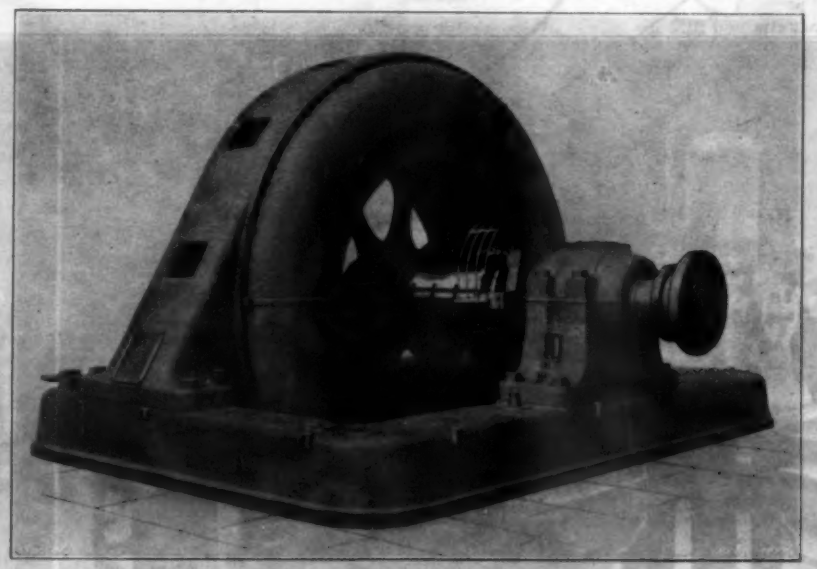


FIG. 10—2000 H.P. 3-PHASE MOTOR

bus-bars supplied by three motor generator sets from the 2200-volt bus-bars, and a starting bus-bar supplied by two compensators.

The large synchronous motors—one of which is illustrated in Fig. 10—are each designed to give 2600 horse-power to the log grinders at 231 revolutions per minute. They are rated at 3100 kVA at 67 per cent. leading power factor in order that magnetising current may be available for energising the step-down transformers, induction motors and other apparatus. Consequently, this magnetising current will not flow over the main transmission

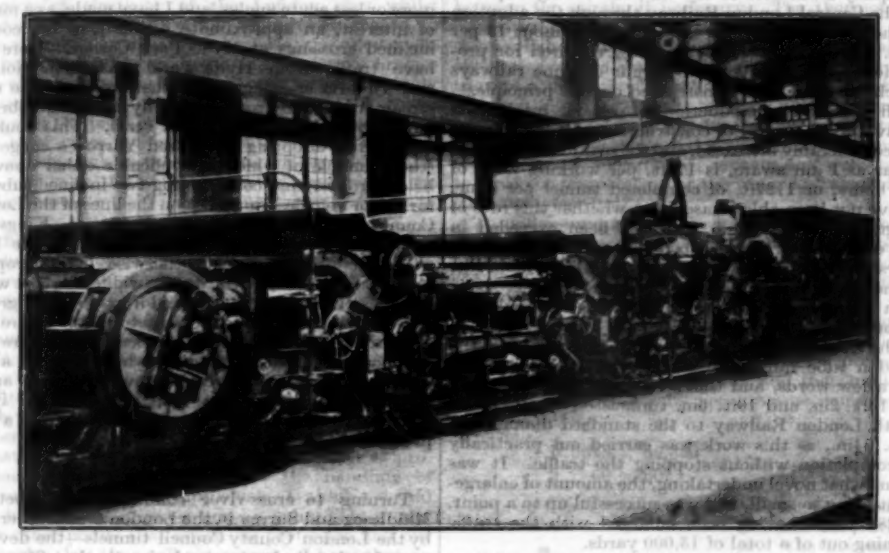


FIG. 12—234-INCH MACHINE FOR MAKING NEWSPRINT—WET END

line which will operate at practically unity power factor. By adjusting the excitation of the synchronous motors, the voltage at the Mill will, it is stated, be kept approximately constant under varying conditions of load.

The output of the Mill—120,000 tons of newsprint per annum—will require 200,000 cords of wood. The timber will be brought to the site by water and by rail, in lengths of about 12ft. As transport by water is impossible during the winter, a large store will be formed near the mill so that a continuous supply of raw material may be forthcoming all the

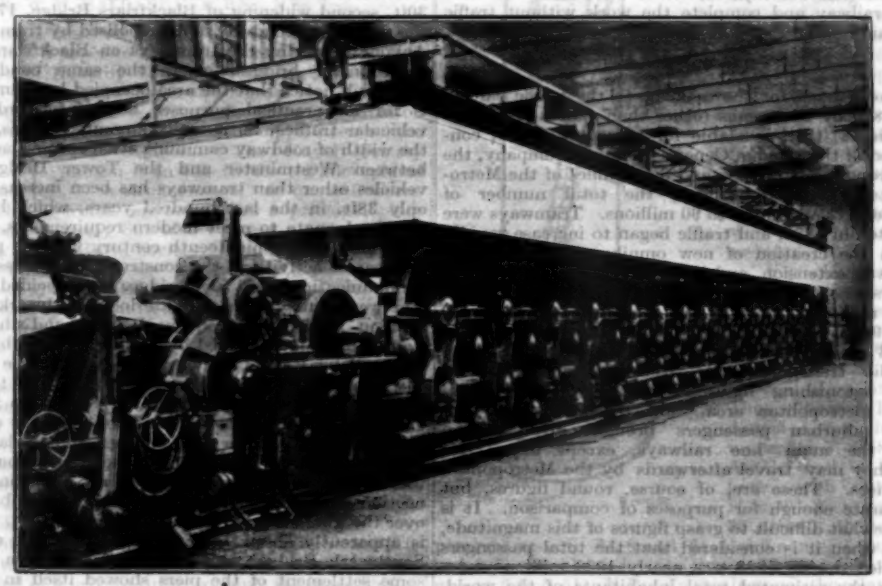


FIG. 13—234-INCH MACHINE FOR MAKING NEWSPRINT—DRY END

year round. After having passed through the "Slasher" House, where the logs will be sawn into lengths of about 4ft., the wood will be conveyed to and from the store to the pulp mill by means of a conveyor belt. The pulp will be made both mechanically and chemically, and in the manufacture of the paper the mechanical and sulphite pulps will be mixed in the ratio of 75 per cent. of the former to 25 per cent. of the latter. There are to be four paper-making machines, supplied by Charles Walmsley and Co., Limited, of Bury, Lancashire, who are members of the Armstrong group. They have a width of 234in. and are, we believe, the largest paper-making machines in the world, the width of the paper produced being 219in. Two views of these fine machines, taken in the shops at the makers' works before dispatch, are shown in Figs. 12 and 13. For heating the rolls of these machines about 200,000 lb. of steam per hour will be required, and it will be furnished by two 25,000-kilowatt electric boilers, supplemented by four Babcock and Wilcox fuel-heated boilers. For driving subsidiary machines in various parts of the mill some 270 electric motors with capacities ranging from 3 to 400 horse-power, are being installed.

The mill covers some 12½ acres and practically the whole of it is being built on reclaimed land formed by nearly half a million cubic yards of earth fill and the driving of over 10,000 piles. Two large store buildings, with a combined capacity of 40,000 tons of paper, have been built on the shore of Deer Lake, where there are berths to accommodate two vessels as well as railway sidings. For the purpose of housing the operatives of the Mill a village is in course of construction at Corner Brook, which will be self-contained and have its own schools, public buildings, &c.

The scheme which is being carried out under guarantees amounting to about £4,000,000 sterling, granted under the Trade Facilities Act and by the Newfoundland Government will, it is anticipated, be completed and the plant fully in operation by July of next year. It may be added, in conclusion, that the Newfoundland Power and Paper Company has timber rights over 1,175,000 acres, which contain a reserve of 10,500,000 cords of wood.

A COLLISION occurred the other day at Stalybridge between an express and a light engine. The signals were at "clear" for the former, and the newspaper reports said that the light engine was crossing the points. As such a movement is not practicable when the signals are "off," it is safe to assume that the engine was engaged in a shunting movement, but was at rest at the time. If that be so, it may further be assumed that the light engine was overlooked, and for such an oversight the remedy is track circuit.

The Institution of Civil Engineers.

PRESIDENTIAL ADDRESS BY BASIL MOTT, C.B.*

I HOPE I shall not be considered prejudiced if I say that, to me at any rate, our profession of engineering is the most useful of all professions, and the finest occupation to which any man can devote his life's work. I do, however, think that what is done by engineers for the use of mankind is not always fairly appreciated. During the past forty years of my life a considerable proportion of the work upon which I have been engaged has been carried out in the neighbourhood of London, and I should like to draw attention, so far as I am able in the time allowed me, to what this great city of ours owes to the engineer, and to what the results of his work have been, more particularly in regard to the development of the means of transport and cross-river communication.

It is not really so very long ago since the only means of travelling from one part of London to another, for the vast majority of the population, was by walking. Carriages were only for the very few. There were a certain number of "hackney coaches" before the introduction of the "cab" in 1820, but no serious attempt to provide public conveyances at a moderate price in a systematic manner was made till the London General Omnibus Company started to run omnibuses in 1856. From that date to the present time this company has served the travelling public well; how well is readily shown by the number of passengers carried, which has risen from 42 millions in 1870 to the astounding figure of 1040 million passengers during last year. When you consider that all the railways in England, Scotland, and Wales, excluding the London area, together only carried 1292 million, or about 250 million passengers more than the London General Omnibus Company alone, it will be realised what this company has done for London.

The introduction of railway facilities in the inter-urban district of London was much delayed, and it was not till 1863 that the first section of the Metropolitan Railway, from Bishop's-road to Farringdon-street, was opened for public traffic. The opening of the Metropolitan Railway was the beginning of a period of great activity in the promotion of underground railway schemes of a similar character. In the area at present surrounded by the Inner Circle alone there were in a few years forty schemes for underground railways; many proposed to cross the parks from north to south, but the majority of the lines were to run more or less from east to west. They were to be worked either by steam or pneumatic power. Unfortunately, or perhaps fortunately, these schemes were not carried out, and except for the many extensions of the Metropolitan Railway Company and of the Metropolitan District Railway Company, which was founded in 1864 and opened its first section from High-street to Gloucester-road and Westminster, no other railway facilities of moment were given to the people of London till the year 1890.

Tube Railways.

The next great wave of activity in the promotion of railways in the Metropolis—made in an endeavour to give greater travelling facilities and to relieve the congestion, which even in those days was causing anxiety—began in 1885, when the first Act was obtained for the first of the so-called deep-level Tube railways. I do not propose to deal in much detail with the method of tube railway construction. I should, however, like to take this opportunity of saying a word or two about the engineer who was the pioneer in the construction of tube railways, namely, James Henry Greathead. I think there are few engineers to whom the travelling public of London owes a greater debt of gratitude than to him. I do not propose to enter into the controversy which took place for a considerable time over the shield which bears Greathead's name, but he was at any rate the designer of the first shield for tube railway construction and the first engineer to construct a tube railway. I think it is a great tribute to his foresight and ability as an engineer that, although about 80 miles of tube railway tunnels have been constructed by other engineers since his death twenty-eight years ago, the methods of construction he originally adopted and the shield used is still in accordance with his original design, except for some modification in detail, and the introduction of mechanical excavation.

New ideas and inventions such as Greathead's stimulated activity, and between 1885 and 1890 no fewer than seventeen new schemes for tube railways were proposed, but none of them received parliamentary sanction. Immediately, however, the City and South London Railway was opened in December, 1890, the possibilities of this type of railway were proved. There was then another period of activity similar to that which followed the opening of the first section of the Metropolitan Railway in 1863. Parliamentary Committees began to look with more favour on new schemes brought before them, and between 1890 and 1900 thirty-two new tube railways were proposed and seventeen were authorised. Then, however, from 1900 to 1902 came a period of disappointment as regards tube promotion. Encouraged by previous success, powerful financial groups competed strenuously with one another to secure for them-

* November 4th, 1924. Condensed.

selves what were considered the most advantageous routes, and out of thirty schemes deposited, nine were for lines from Hammersmith to Charing Cross and the City *vid* the Strand and Fleet-street upon practically the same line. The total length of these thirty schemes amounted to about 100 miles, and the proposed capital expenditure to nearly £50,000,000. A great parliamentary fight took place, the biggest in the history of tube railways. Endeavours were made during the progress of the Bills to amalgamate certain groups, parts of railways were dropped and new junctions and new connections were put forward, till the original lines and estimates as deposited were unrecognisable. It was chaos, the final result being that practically all the schemes were rejected, and out of the 100 miles proposed only 4 miles of new railways were authorised.

It is unfortunate that the existing tube railways have been constructed in a piecemeal fashion, in accordance with the ideas of individual promoters and their advisers, without regard to the interests of London as a whole. The existing railways, good as they are, do not and now never can give that public convenience they might have done had they been carried out as parts of a well-thought-out comprehensive scheme. It ought not to have been difficult forty years ago, when there were no tube railways and there was a clean sheet to write upon.

Before leaving the subject of tube railways there are one or two special points in connection with them that may be of some little interest and may not be universally known, as, for example, the question of size. Why are the main-line tunnels 11ft. 8½in. internal diameter? The original City and South London lines were 10ft. 2in. and 10ft. 6in. in diameter, but this size was a great handicap to the company, as it did not give really sufficient space for the accommodation of a satisfactory type of rolling stock, and in later tubes the internal diameter was made 11ft. 8½in. It is somewhat surprising what a very superior coach this comparatively small increase in diameter gives. There is no scientific reason why the diameter should be the curious figure of 11ft. 8½in. It arose in this way. In a later tube contract the drawings showed the internal diameter as 11ft. 6in., but the engineers concerned were anxious as to the capacity of such a tunnel to take the rolling stock desired by the traffic department, after allowing for the error of line and level which inevitably occurs during construction. As the contract had been let, it was undesirable to increase the *external* diameter and so increase the excavation, &c., and consequently the contract price. After careful consideration it was decided to reduce the depth of the flanges of the cast iron tunnel lining to a minimum. This reduction of the flanges increased the internal diameter to 11ft. 8½in., the outside diameter remaining the same. All other tubes have been constructed to this dimension as a standard gauge, though I hardly think it is generally realised why such a figure was adopted in the first instance.

This figure of 11ft. 8½in. applies, of course, only to the main line tunnels, and in some cases there are as many as eight tunnels and service passages below one street. The station, crossover and junctions tunnels, &c., are of varying sizes up to 30ft. internal diameter, and for short lengths the diameter has reached 35ft. These figures show how readily the London clay, in which the great bulk of tube railways have been made, lends itself to the construction of tunnels of all sizes, and the existence of tube railways is largely owing to the presence and properties of the London clay. Under London the character of the clay varies in a peculiar manner in very short distances. It is usually hard and very tough, and I think if it could be immediately protected in tube railways from the action of the air, great lengths of tunnel would require no lining at all and would keep their circular shape as excavated for an indefinite period; but, on account of the variability of the clay, lining is essential. Under some parts of London, particularly the City, the clay has a peculiar characteristic which is not so apparent further south or west. If you drive a bar into the clay in this area and withdraw it, leaving a circular hole, you will find that in the course of about an hour the hole will be completely closed; in other areas it will remain undiminished in size apparently indefinitely.

There is another peculiarity of the London clay which is a constant source of anxiety to those engaged in tube construction, and that is the extreme irregularity of the surface, which bore-holes—those most misleading of things—cannot in any way be relied upon to detect. The clay sometimes ends in an almost vertical face. Borings may show 15ft. to 20ft. of clay above the proposed line of the tunnel, and miss an adjacent depression altogether, so that you are suddenly confronted with gravel and water, sometimes with serious results.

Another thing which brings excitement and interest to engineers and contractors engaged in these burrowing pursuits is the existence—dotted all over London—of wells, sunk apparently in ancient times, of which there exists no record whatever. When met with underground they usually collapse, and as they are filled with a black and slimy material which has apparently been decaying for centuries, the situation is not particularly agreeable.

There is another point in the general design of tube railways, apart from details (which I have endeavoured to avoid), which I regret has not been developed as it might have been. That is the adoption of gradients for acceleration and deceleration on leaving and approaching stations. This was attempted on the old City and South London Railway, but was not adhered to systematically, and the practical advantage is not easy to detect. On the Central London Railway, however, the tunnels were constructed so as to give a fall of 10ft. on a gradient of 1 in 30 for acceleration on leaving each station, and a rise of 10ft. on a gradient of 1 in 60 on approaching each station for deceleration, reducing the braking to a minimum. By the courtesy of the London Electric Railways Company I am able to say that the saving in power on the Central London Railway through the adoption of the gradients referred to amounts to about 15 per cent. as compared with the power required for propulsion of trains of similar weight on tube railways which have not been constructed on this principle.

Through the introduction of rotary mechanical excavators the speed of construction of tube railways has considerably increased, and the maximum reached, so far as I am aware, is 170ft. per working week of 134 hours, or 1.27ft. of completed tunnel per hour. I have not been able to ascertain whether this rate of progress for completed work has been exceeded in any other country, but I believe not. It applies, of course, only to the comparatively small main-line tunnels, and I am of opinion that it is a higher speed than should be allowed, except under special conditions.

There is one other point in connection with the London tube railway system about which I should say a few words, and that is the enlargement of the old 10ft 2in. and 10ft. 6in. tunnels on the City and South London Railway to the standard diameter of 11ft. 8½in., as this work was carried out practically to completion without stopping the traffic. It was a somewhat novel undertaking, the amount of enlargement being so small, and was successful up to a point, 10,280 yards having been enlarged with the traffic running out of a total of 13,000 yards.

Special shields through which the trains could run during the day were constructed so as to encircle the old tunnels, the lining of which was removed as the shields were driven forward. These shields cut away the excavation necessary for the enlargement, and the new tunnel segments were erected under cover of the shields which supported the ground between the small and enlarged tunnels when traffic was running. Unfortunately, shields could not be used in all places owing to the necessity of adjusting the original errors of construction, and in these places the enlargement had to be carried out by hand with ordinary poling boards. On November 27th, 1923, an accident, which might have been extremely serious, happened through subsidence of the ground at one of the hand-driven faces. Fortunately the trains were stopped in time and no one was injured, but it was decided to close the railway and complete the work without traffic running.

London Traffic.

Going back for the moment to the traffic carried in 1870 by the means (other than cabs and private carriages) then available for transport, which consisted of the London General Omnibus Company, the Metropolitan Railway, and a few miles of the Metropolitan District Railway, the total number of passengers amounted to 90 millions. Tramways were started in 1870, and traffic began to increase rapidly with the creation of new omnibus companies and railway extension, and in 1880, after a period of ten years, the number of passengers carried had risen to 220 millions. In 1890 the total was 460 millions. In 1900 it reached a total of over 800 millions, and in 1923 the total passengers carried by all methods of public transport other than taxi-cabs reached the astonishing figure of about 2600 millions in the metropolitan area, and this is exclusive of the suburban passengers brought into London by the main line railways, except in so far as they may travel afterwards by the Metropolitan services. These are, of course, round figures, but accurate enough for purposes of comparison. It is somewhat difficult to grasp figures of this magnitude, but when it is considered that the total passengers carried during 1923 was nearly 1000 millions more than the estimated total inhabitants of the world, the vastness of the problem becomes apparent, and the greatness of the organisation that makes it possible should be a source of national pride.

This enormous and increasing movement of people from one part of London to another emphasises the fact that in large cities the greater the facilities for rapid transport at reasonably cheap rates, the greater the volume of traffic. You will not, I think, by adding to the number of deep-level tubes or of shallow railways decrease the present very serious congestion which is hampering the development of London to a dangerous extent. Some radical steps will have to be taken in the next few years if locomotion in our main thoroughfares is not to become a farce, and the most rapid way of travelling above ground to be by walking, as in the very early days when there were no facilities at all. If new streets are the only solution, I sincerely trust they will not be overhead to disfigure for ever our great city. If there must be new streets let them be underground, and such a proposition is, I think, by no means impossible. No doubt there are other ways of giving relief at local points where congestion is particularly acute, and personally I think that the suggestion recently brought forward with some prominence by Sir Alfred Yarrow to obviate the blocking of traffic at the intersection of main streets, by the construction of inclined crossings, is worthy of very serious consideration. Many objections to such inclined crossings have been and will be raised. Of course, they are not a perfect solution of the difficulty, but at certain specific points they would be of considerable value, and the cost should not be prohibitive.

The traffic regulation is most difficult, not where roads meet at right angles, but where they meet at more or less acute angles, and I have made, as a matter of interest, an approximate estimate of the cost of inclined crossings at Hyde Park Corner. Here you have traffic from Hyde Park to Constitution-hill and Victoria crossing in various directions the main stream of traffic from Piccadilly to Knightsbridge, and also to Victoria and *vice versâ*. This could be avoided by adopting Sir Alfred Yarrow's suggestion (the principle of which is applicable either above or below ground) and constructing two inclined subways for motor vehicles somewhat on the lines of the London County Council tramway subway at Kingsway. Some modification of the roadway in Hyde Park would be necessary, but otherwise little property would be required, as the area is wide. The cost would be approximately £150,000, and if made below ground there would be no superstructure to injure the æsthetic beauty of this magnificent site, where congestion is severe. I hope that where possible a trial may be given to Sir Alfred Yarrow's proposal, and to some of the many other suggestions made in an endeavour to find some practical solution to a very pressing problem.

Bridges.

Turning to cross-river communications between Middlesex and Surrey in the London area—other than by the London County Council tunnels—the development has hardly kept pace during the last fifty years with the growing needs of the population.

This view is rather emphasised when it is realised that from Vauxhall Bridge to the Tower Bridge, both inclusive, we have only added 85ft. of width of roadway by bridges across the river during fifty years. It is perhaps even more surprising that, taking the central area of London, that is, from Westminster Bridge to the Tower Bridge, a distance of nearly 2½ miles, only 55ft. of width of roadway has been added to our cross-river communications since 1831, or in nearly a hundred years. The only additions have been the widening of Blackfriars Bridge by 48ft. in two stages and the reconstruction of Southwark Bridge, which was made 7ft. wider than the old bridge designed by Rennie and completed in 1819. Even this is somewhat misleading, because, of the 30ft. second widening of Blackfriars Bridge, 17ft. at the side of the roadway is monopolised by tramways. Anyone observing the tramways on Blackfriars and Westminster bridges, where the same conditions exist, will notice that the area occupied by tramways is for all practical purposes useless for ordinary vehicular traffic. So it really amounts to this, that the width of roadway communication across the river between Westminster and the Tower Bridge for vehicles other than tramways has been increased by only 38ft. in the last hundred years, which hardly seems adequate to meet modern requirements. The early part of the nineteenth century was the period of greatest activity in the construction of cross-river communications, and four bridges were decided upon and were built, namely, Waterloo, Southwark, and London Bridge designed by Rennie, and the old Vauxhall Bridge designed by Walker. In the bridges designed by Rennie, as was customary at the time, the piers and abutments were founded on timber piles driven into the bed of the river. Two layers of heavy cross timbers were laid on the tops of the piles and planked over with another timber platform about 6in. thick, upon which the actual masonry was built. A somewhat interesting point in connection with the timber foundations of these bridges over the Thames is the length of time they last, which is apparently about 100 years. In the case of the Southwark Bridge, which was commenced in 1814, some settlement of the piers showed itself in 1890, and increased gradually till the reconstruction of the bridge in 1913. In reconstruction the number of arches was altered from three to five, and it was necessary for navigation purposes to remove the old piers and their timber foundations entirely. They were removed inside cofferdams, so that the actual condition of the timber was shown beyond doubt. The piles themselves were generally well preserved, but the horizontal timber platforms had deteriorated so seriously that the heads of the piles pierced into them. The masonry had, of course, followed the sinking platform, causing settlement after a period of 100 years.

Waterloo Bridge, which was constructed in the same manner as Southwark Bridge so far as the foundations are concerned, was opened in 1817, and has for many years shown signs of gradual settlement. As is now well known, this movement increased rapidly about June, 1923, particularly in one of the piers of the centre arch, and the bridge was closed for traffic by the London County Council in May, 1924, during temporary repairs. From close inspection

there is no doubt that this settlement is due to the deterioration of the timber platform, as at Southwark, and the period is also a little over 100 years. London Bridge was completed in 1831, and if it follows the example of Waterloo and Southwark we may expect trouble with the foundations in the next ten or twenty years.

Old Westminster Bridge, designed and constructed on a pile foundation by Charles Labelye, was opened for traffic in 1749, and about 100 years later, in 1856, the centre arch subsided, as in the case of Waterloo Bridge. It was then removed and replaced by the present structure.

I should like to refer again for a moment to the question of elasticity of the London clay whilst touching on the work of the engineer in regard to cross-river communication, because the movement can be more readily perceived on the piers of bridges than elsewhere. This has lately been rather strikingly illustrated during observations taken at Waterloo Bridge on the piers of the central arch. It was found that these piers rise and fall with the tide—that is to say, they sink as the tide rises and rise as the tide falls, owing to the weight of water compressing the elastic foundation. The movement is about ½in. to $^{3}/_{16}$in.

I think that this movement really extends for some distance north and south of the river itself, probably for several hundred yards to a degree which is quite perceptible with precision instruments. Observations which are being made at St. Paul's Cathedral show certain vertical movements of the structure as a whole, but these observations have not yet been carried over a sufficiently long period to enable me to give the amplitude of the movement which certainly occurs and is probably tidal.

There is much that I should like to say in reference to matters I have very much at heart, such as professional training and education, the handling of contracts, the relationship which, I think, should exist between the engineer and his subordinates, and many other points that affect our profession and our Institution, but time will not permit. I hope that, in the struggle for existence, which at the moment is severe, whatever happens, we shall never forget the priceless heritage that has been handed down to us, of honour, of courtesy, and of consideration and help from one professional man to another in time of difficulty and trouble. I know so well what it means, for without that help and kindliness I have been so fortunate as to find everywhere, I should, on more than one occasion, have fallen badly in my professional career.

Joule's Law of Electric Heating: An Historical Sketch.

By W. W. HALDANE GEE, B.Sc., M.Sc. Tech.

James Prescott Joule towards the end of 1840 presented a paper to the Royal Society "On the Production of Heat by Voltaic Electricity," which contained the first statement of his great law of electric heating—a law which governs the electric production of heat from the small domestic appliances to the gigantic electric furnaces. The Royal Society declined to publish it in full in the "Philosophical Transactions," "a circumstance," to quote Osborne Reynolds, "which not only takes a principal place in Joule's career, but also secured a place in the history of the Royal Society." In the short abstract which appeared in the "Proceedings," Joule stated his law in this form: "Calorific effects of equal quantities of transmitted electricity are proportional to the resistance opposed to its passage, whatever be the length, thickness, shape or kind of material which closes the circuit, and also that, *cæteris paribus*, these effects are in the duplicate ratio of the quantities of the transmitted electricity."

Any details of the original experiments which enabled him to deduce this important law will be of historical interest. They are to be found in his Laboratory Notebooks, which have been preserved in the Physics Department of the Manchester College of Technology. Hitherto, no literary use has been made of these records. The earliest of the volumes is of particular value, showing the transition of Joule, the pupil of a private tutor, to Joule the investigator. In an unruled manuscript book, 9in. long, 7½in. wide, and ¾in. thick, are written with great care and accuracy the rules of arithmetic, specimens of bookkeeping, and the properties of conic sections, all most probably done under the direction of Mr. Tappenden, who prepared Joule and his brother to receive lessons from the famous John Dalton. Three original manuscripts of early papers are included in the book, but the remainder of the blank pages and the vacant spaces of the bookkeeping have been utilised for sketches of the designs of the electromagnets, invented by Joule, and described in his first papers, and for laboratory records.

The first entry is dated November 15th, 1839, Joule then being nearly twenty-one years of age. It relates to experiments on electromagnets, which were made in a room at his father's house at Broom Hill, Pendlebury, near Manchester. In 1840 he turned his attention to the electrical production of heat, and his first experiment is recorded in this statement:

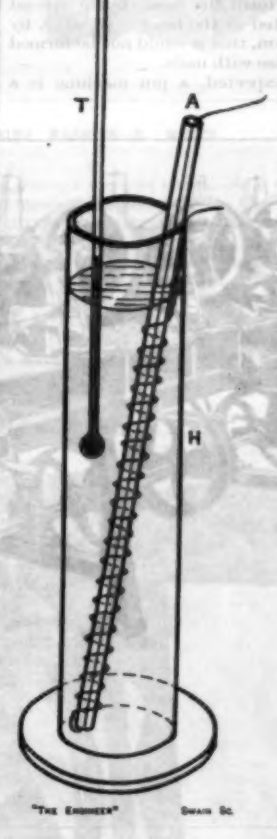
"Latter end of August 1840 I took 1½ lbs. of rain water of 68½ farenheit, also 4 feet of copper wire 1/50 inch thick coiled on a glass tube and returning by its interior. This placed in a glass vessel filled with the water (atmospheric temperature 68) raised with a current of 39°.1, continued during 85 minutes the temperature of the water to 70, the extremes of electricity 35° and 46°."

The apparatus used is illustrated by a small and rough sketch. In the *Philosophical Magazine*, Vol. 19, page 260, a more elaborate drawing of this first electrical calorimeter will be found, from which the accompanying engraving has been reproduced. In the glass cylinder H is the glass tube A, on which the copper wire is spiralled, cotton thread being interposed between the spirals, if necessary. The thermometer T was an open scale one, enabling the tenth of a degree Fahrenheit to be estimated with certainty. When the current passed through the naked wire, no trace of a short circuit could be detected through the rain water, either by the evolution of gas or the oxidation of the copper. Before taking temperatures, the water was gently stirred with a feather. Previous to starting an experiment, precautions were taken to have the temperature of the water and that of the laboratory nearly the same.

To understand the meaning to be attached to the value of the current, given as 39.1 deg., it must be remembered that Faraday had already published his laws of electrolysis. This enabled Joule to fix a definite unit of electricity. He decided to adopt that strength of current which is able to decompose 9 grains of water per hour. To express this in modern terms, it is only necessary to convert the 9 grains per hour into 9 grammes per second, and then multiply by the *Faraday* (coulombs per gramme equivalent), and thus obtain:

$$\frac{9 \times 0.0648 \times 96{,}500}{9 \times 60 \times 60} = 1.74 \text{ ampères.}$$

A primitive type of galvanometer was used to indicate the current and the instrument was standardised by the help of a gas voltameter.



After further preliminary experiments, on September 15th a test of the law of heating was directly proceeded with, Joule employing a method which he used later in measuring specific heats. Two equal calorimeters were placed in series, the resistance in one being 15ft. 10½in. of copper wire, $^{1}/_{28}$in. in diameter, and in the other 5½ft. of a thicker copper wire, $^{1}/_{16}$in. thick. He found that the relative rises of temperature were approximately as the relative resistances of the wires. He next tried wires of different metals:

"Sep 16, 1840. Temp of room 58.4, ½ lb. of rain water in each glass. Iron wire 1/27 diameter, 6 ft. long immersed in water. T = 58.8. Thin cop wire 1/50 diameter, 6 ft. long immersed. T = 58.6. At the end of one hour with mean E = 39°.3 extremes 38° and 40°, the temperature rose to 64.8 and 64.1, differences being 6 and 5.5, while the resistance obtained by careful exps. was as 6 to 5.51. N.B.—In this instance the relative conducting powers of iron and copper for equal weights was as 13 to 35."

"Oct 2. T of room 59. T of the ½ lb. of rain water 59 ——— feet of 1/50 in. diam. copper wire. 3 iron batteries in half an hour with a mean of Elec. 57½ extremes 59° and 57½°. T was raised to 82°, being 23° Farenheit. Compare with last exp. and it will be seen that the heating power is as the squares of the electricity."

In these two experiments Joule had proved that the heating effect was directly proportional to the resistance and did not depend on the metal, and further, that the heating was directly proportional to the square of the current strength. He had previously satisfied himself that it was directly proportional to the time. Writing the complete law in the modern form we have

$$I^2 R t = J H,$$

where I = current strength in ampères, R = resistance in ohms, t = time in seconds, H = heat produced in calories, and J = Joule's equivalent, approximately of the value 4.2, or

$$\text{Joules} = \text{Joule's equivalent} \times \text{calories},$$

in which statement Joule's name is honoured twice.

In the experiment of September 16th it was necessary to know the relative values of the iron and copper resistances, which was obtained "by careful exps." as 6 to 5.51. His calibrated galvanometer enabled him to make the measurement by inserting in turn in the circuit the resistances to be compared. It is a testimony to the accuracy of Joule that he was able to get such good agreement between the sets of numbers when his calorimetric and galvanometric methods were so primitive.

In the record of October 2nd he tells us that three iron batteries supplied the current. The cells were made of plates of amalgamated zinc and cast iron, excited with dilute sulphuric acid. He found this type of primary cell very suitable for heating experiments; with eight cells of a foot square and 1½in. internal diameter he was able to raise to full red heat 18in. of copper wire $^{1}/_{16}$in. thick. This type of cell is usually known as Sturgeon's, but it had been previously described by Roberts.

It is not possible to check the result deduced from the numbers of October 2nd, for the reason that a blank has been left where the length of the copper wire immersed should have been recorded. Joule used a slate for his direct results and details written there are not always recorded in the book. However, from his published paper, coupled with later experiments, it is possible to show how he deduced to his own satisfaction the law of squares. It may be here remarked that the term *duplicate ratio* used in his original statement of the law he must have discarded, for duplicate ratio, as defined in the Fifth Book of Euclid, has a special meaning. The final experiments were all made with 11½ft. of copper wire $^{1}/_{16}$in. diameter immersed in ½ lb. of water. Combining the information furnished in the manuscript with that published in the *Philosophical Magazine* we find:—

Current in degrees.	Current in Joule's units.	Temperature rise, deg. Fah.	Time, min.	Temperature rise Current squared.
55	2.35	19.4	30	3.5
57½	2.61	23.0	30	3.4
58½	2.73	25.6	30	3.4
16	0.43	1.2	60	2 × 3.2
31.5	0.92	4.7	60	2 × 2.6

As Joule remarks, the differences from the law of squares "are very inconsiderable, taking into account the nature of the experiments."

Joule has often indicated by pencilled numbers the laboratory observations that he selected for publication. The one numbered 688 reads as follows:—

"Oct. 5. T of R 57. 11½ft. of wire $^{1}/_{16}$ diameter. 22½ in mercury of diameter 0.065. ½ lb. of R.W. in each. 16 yds. interposed for resistance.

Wire heat.	Mercury heat.	Time, minutes.	Galvanometer, degrees.
57.4	57.4	0	27
58.4	58.2	10	26½
59.3	58.8	20	26
60.1	59.3	30	25
60.7	59.6	40	25
61.2	60.0	50	25
61.6	60.3	60	25

Copper for equal wts. conducts 43.3 times better than mercury. In this case the mercury's resistance = 7½ft. $^{1}/_{16}$ copper wire. Wt. of mercury 393 grs."

In this test the mercury was enclosed in a bent glass tube. At the end of an hour the rise of temperature of the calorimeter containing the wire was 4.8 deg., and in that with the mercury 2.9 deg. Since 7½ft. of the copper had the same resistance as the mercury, the 11½ft. in the calorimeter would have a resistance compared with the mercury as 4.5 to 3. This experiment is an additional confirmation of the resistance law, but the figures are more especially of interest, for they furnish data enabling the specific resistance of mercury to be compared roughly with that of the copper wire used by Joule. On making the calculations it is found that the copper he used must have had a relatively low conductivity as compared with modern copper.

The early temperature measurements were made without corrections for cooling and the water equivalent of the calorimeter. He next decided to apply these corrections and to make new determinations with a unit of resistance. This was a great step forward, and his selection of a unit of resistance is of considerable historic interest. His unit consisted of 10ft. of copper wire 0.024in. in diameter. With it he made more exact heating experiments and found that with the necessary corrections that 1.88 of his unit of current passed through this resistance for an hour raised 2 lb. of water 7.56 deg. Fah.; hence (applying the necessary conversion factors) its resistance will be

$$\frac{J H}{I^2 t} = \frac{4.2 \times 2 \times 454 \times 5 \times 7.56}{9 \times (1.88 \times 1.74)^2 \times 3600} = 0.416 \text{ ohms.}$$

This unit of resistance he uses throughout the investigations which follow. It will be found from the tables of conductivity that if the wire had been pure its resistance would only have been 0.177 of an ohm; hence Joule's copper could only have had a conductivity of 42.5 per cent. of the wire now in use.

The copper wire in 1840 was of a poor quality. A

sample of wire from an old induction coil made by J. B. Dancer, who constructed much of the apparatus used by Joule, had a specific resistance of 4.6×10^{-6} ohm-cm. units, which is equivalent to a conductivity of 37 per cent. It cannot be certain that this is the original value, for the copper had become during the eighty years crystalline in structure. Another sample from one of the electromagnets in the Joule collection was of conductivity = 41.5 per cent.

A very difficult task was now attempted by Joule. Did his laws of heating apply to the cells of a battery and to electrolytes? In attacking this question he had now three working units:—

(1) A unit of resistance.
(2) A unit of current strength.
(3) A unit of heat, which was the amount of heat required to raise 2 lb. of water through 1 deg. Fah. Later he used the usual unit of half this amount.

The laboratory records show that these units were used first in connection with the heat produced inside a cell of the type designed by Smee; then followed many trials with other cells. These experiments directed his attention to the conversion of chemical energy into that of heat. The records of this work entailed thousands of entries in his laboratory books. There are over 100 pages of these, extending to March, 1843, after which he commenced his epoch-marking work on the mechanical equivalent of heat. From the law of heating standpoint the most convincing experiment with electrolytes was with a copper voltameter in which there was no "*resistance to electrolysis.*" He found that the heat actually produced when a current was passed agreed very well with that he had calculated, and then he finally concluded that generally:—

"*The heat which is evolved by the proper action of any voltaic current is proportional to the square of the intensity of that current, multiplied by the resistance to conduction which it experiences.*"

This concludes a short history of the discovery of the law of heating, but only by an inspection of the laboratory records can there be any real estimate made of the great labour that it involved.

Obituary.

SIR WILLIAM CRESSWELL GRAY.

THE shipbuilding industry and the town of West Hartlepool have suffered a severe loss by the death of Sir William Cresswell Gray, Bart., which occurred at Thorp Perrow, Bedale, in Yorkshire, on Saturday last.

William Cresswell Gray was the last surviving son of the late Sir William Gray, who was among the first to introduce iron and steel shipbuilding at the Hartlepools, and the founder of the shipbuilding firm of Wm. Gray and Co., Limited. He was born on May 1st, 1867, and was, therefore, only in his fifty-eighth year at the time of his death. He was educated at Leys School, Cambridge, and early joined the firm of Wm. Gray and Co., of which he was made a partner and director when the undertaking was made a limited liability company in 1889. He subsequently became managing director, and, on the death of his father in 1898, chairman. He also acquired in 1899 the West Hartlepool Steel and Iron Works, the Moor Iron and Steel Works, and Malleable Works at Stockton-on-Tees, which he, with the aid of the late Lord Furness, combined under the title of the South Durham Steel and Iron Company, Limited. He was also a director of the North-Eastern Railway Company, and of the Pyman Steamship Company, Limited.

Sir William, who was created a Baronet in 1917, was a Deputy Lieutenant for the County of Durham, and had acted as High Sheriff, and he was also a member of the Hartlepools Port and Harbour Commission and of Lloyd's Register. He had been in failing health for some considerable time past, but he had, nevertheless, deeply interested himself in the new shipyards and graving docks which his firm is building on the Tees.

He is succeeded in the Baronetcy by his son, Sir Wm. Gray, who was born in 1895.

SIR PERCY CROSLAND TEMPEST.

IT is with great regret that we have to record the death from pneumonia following a chill, of Sir Percy Crosland Tempest, which took place in London on Monday morning last.

Sir Percy, who was the son of Mr. Charles Tempest, a solicitor of Leeds, was born in 1861. He received his scholastic training at Leeds Grammar School, afterwards passing through the University of that city. He was twice articled as an engineer, first to the borough engineer of Leeds and subsequently to the divisional engineer of the then London and North-Western Railway at Leeds. In 1882 he came south to enter the service of the old South-Eastern Railway Company, in the engineering department of which he filled various positions, becoming assistant engineer in 1896, and being made chief engineer of the joint South-Eastern and Chatham systems, when the amalgamation of those undertakings was effected in 1899. Twenty-one years later he was also entrusted with the general managership of the line. In 1923, when the South-Eastern and Chatham was absorbed in the Southern Railway, Sir Percy was made joint general manager with Sir Herbert Walker of the new combination, retiring when Sir Herbert was made sole general manager.

Sir Percy was an ardent supporter of the Channel Tunnel project, and he had been engineer to the British Channel Tunnel Company since 1916.

During the war and subsequently, Sir Percy did excellent work as agent for the Northern Railway of France and for the Belgian State Railways, for which he inspected and purchased large quantities of railway equipment, including bridge-building material, rails, &c. He was also responsible for the necessary civil engineering works which were carried out when the British War Department extended the military base at Boulogne in 1914. For his war services he was created C.B.E. in 1918, becoming K.B.E. in 1923. He was also made a Chevalier of the Légion d'Honneur, and received the Belgian Croix d'Officier de l'Ordre de Léopold. He was also a Knight of the Order of the Dannebrog.

Sir Percy entered the Institution of Civil Engineers as a Student, becoming an associate member in 1886 and a full member in 1897.

British Wire-drawing and Wire-working Machinery.

No. XV.—PIN-MAKING MACHINES.*

IT is said that the wire-drawing industry was first introduced into this country on account of the demand for pins at the court of Queen Elizabeth, but the process of making the pins was then totally dissimilar from the system now universally adopted. In the early days pins were made by hand, individually, and the heads were formed by little rings of wire squeezed and soldered on to the stem. The modern system is to upset the metal to form the head, but a special process has to be adopted as the head is so large, by comparison with the stem, that it could not be formed at one blow, as is the case with nails.

As would only be expected, a pin machine is a comparatively small affair, a fact which can be judged by a reference to Fig. 117. This engraving shows five machines, by Mr. Edward White, of Redditch, and it will be seen that the whole set occupies only a few square yards of floor space. The output of pins is, however, really remarkable when account is taken of the number of movements necessary for the production of each pin. The set of machines illustrated is capable of turning out 45,000 pins an hour, and was made for a factory in South America.

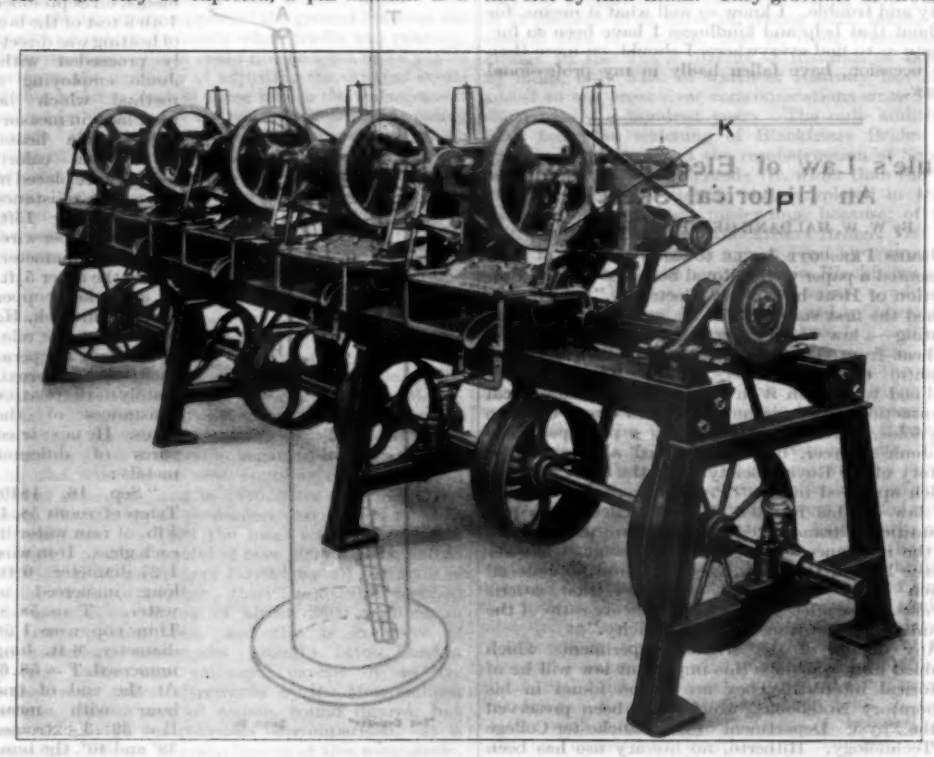


FIG. 117—BATTERY OF FIVE PIN-MAKING MACHINES—E. WHITE

The operation of the machine can best be followed with the aid of the sketch, Fig. 118, from which it can be seen that the stock of wire is carried on a swift at the back, and is straightened by a set of pegs—the length of wire required by each pin is so short that pegs will make it quite straight enough without the added complication of a spinner. The wire is led through a little tunnel die, at the outlet end of which there is a cutting-off knife operated by the lever A. It is necessary that the wire should be cut off very neatly and without a burr, as any irregularity in its end would spoil the shape of the coming head.

The feed of the wire is effected by the grips B, which are opened and closed by the side lever C and a cam on the main shaft. The reason for putting this lever right over at one side is to leave the top of the machine accessible. The feeding movement is given by a second cam. It will be noticed that the end of the lever C is bent down and engages a spring to return the grips on the back stroke. The feed has to be effected in three separate stages. First, the wire is brought forward so that it extends about $^1/_{16}$in. beyond the front of a pair of gripping dies. Then, as the head is formed, the wire is again fed forward $^1/_{32}$in. in two separate steps, while the other heading blows are struck. These secondary feeds, which are produced by very fine steps on the cam, are effected so quickly that they cannot be observed by the eye when the machine is running. They can, however, be felt with a finger on the feed slide and are quite definite.

The gripping dies just mentioned are operated by the cam D, which moves a ram running beneath the top cover of the machine. This ram terminates in a wedge-shaped piece, which, when driven forward, closes the dies. The dies, by the way, have to be made very carefully, as if they produce any flats on the wire the pin point cannot be formed, while the grip must be sufficiently tight to withstand the heading blows. Incidentally the mechanism has to be made and adjusted very accurately as the gripping dies have to be opened three times for the formation of each pin head—twice while the secondary feeds for heading take place and again when the head is complete. In this connection it should be pointed out that all the cams are keyed rigidly on to the shaft, so that when once set they cannot be moved. This rigid attachment naturally involves very careful workmanship in erection.

The three blows for setting up the head of the pin are all struck by one die, the adjusting screws for which can be seen in Fig. 118 at E, while the working cam is marked F.

The headed pins fall down between the gripping dies when they open for the third time, and are caught in a shoot G below. This shoot has a very narrow slot running down the centre, and the pins hang in this slot by their heads. They gravitate downwards and are guided round a gentle curve at the bottom into a transverse slot H, running across the front of the machine. It is a peculiar thing about the working of these machines that when they are first started up the pins are rather sluggish in going down the shoot, but after running a short time the edges of the slot become glazed over with a thin film of metal from the pin wire, and then the pins descend the shoot quite smoothly.

The pins are pointed as they traverse the groove H, in the following manner:—

Below the table there is a long grinding mill, supported at one end in the bearing J and driven at a speed of some 4000 revolutions per minute. In the case of brass pins, the mill is formed as a number of hard steel sleeves, cut with file teeth, and held on to the spindle by bands. This construction is adopted as is simplifies the renewal of the first sections of the mill, which wear blunt more rapidly than the others. For steel wire pins a carborundum or emery grinding mill is used.

* No. XIV. appeared October 31st.

If the pins were merely fed across the face of this mill, they would receive a hollow ground point, which would not be stiff enough for service. They must have an ogival point, and for this reason the end of the mill is made to travel through an appropriate path. The mechanism for performing this function is best shown in Fig. 117, in which it will be seen that there is a crank pin on the end of the main driving shaft, and that this crank operates a connecting-rod K—also shown in Fig. 118. The lower end of this connecting-rod carries one of the bearings for the mill, and

The lever O—see Fig. 118—bears against a cam on the main shaft and oscillates a horizontal shaft P—see Fig. 117. The peculiar shape of this lever is, by the way, caused by the necessity for it to clear the shoot down which the pins slide. On each end of the shaft P there is an arm that bears against the face of the bar L, which is consequently pushed away from the pins every time the cam moves the lever O forward. The cams are so formed that the bar L moves twice to the right and once to the left in contact with the pins, but on the second stroke to the left the bar

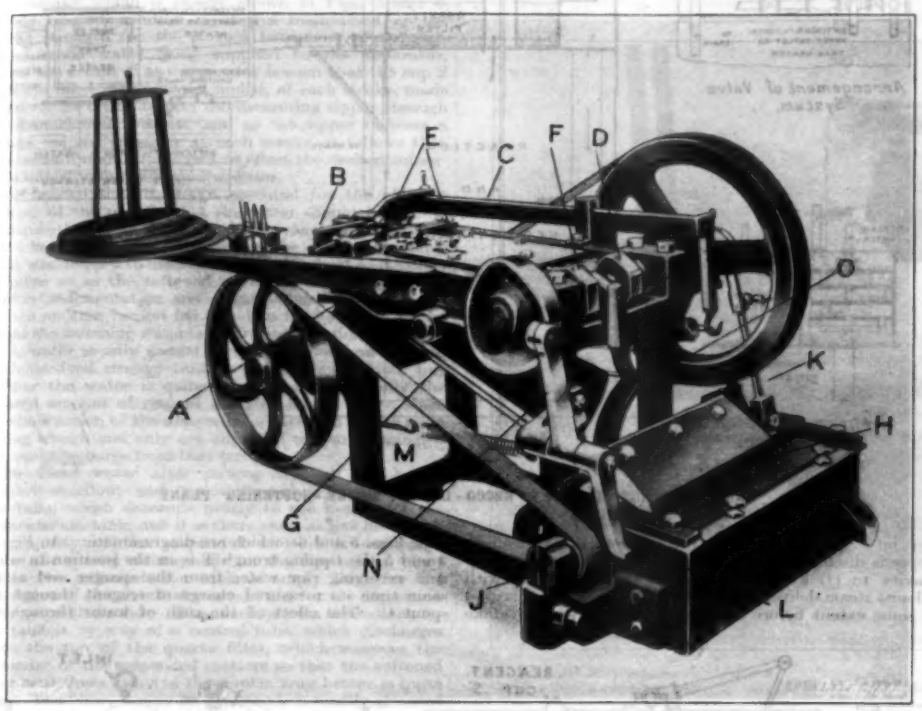


FIG. 118—AUTOMATIC PIN-MAKING MACHINE—E. WHITE

is pressed against a little stationary former. The former is so shaped that as the connecting-rod reciprocates the bearing, the working face of the mill traces out the desired shape of point. It will be obvious that the two bearings have to be coned to accommodate the movement of the mill, and that the movement will be angular, gradually increasing with the distance from the driving end. In this way the beginning of the mill is made to rough out the points, while the end gives them their final form.

The arrangements for feeding the pins along the slot H, front left to right, are very ingenious and are shown in Fig. 118. There is a bar running across the machine under the table, the end of which can be seen at L. This bar is in front of the pins hanging in the groove H, and is pulled up against them by the spring M. The bar is reciprocated by the cam seen on the end of the main shaft, through the rocking lever N, and consequently rolls the pins backwards and forwards across the face of the mill so that the point is ground truly circular. This movement would not, however, feed the pins forward, and another movement has consequently to be introduced.

is pushed clear of them. As a consequence, the pins progress intermittently to the right, and are finally delivered by a shoot into any convenient receptacle.

The range of sizes of pins that can be made on one machine is governed by the length, which can vary by ¼in. It is therefore usual to arrange five machines on one bed, so that all the sizes of pins in general use can be made. The diameter of the wire does not affect the machine, but it is essential that the wire should be quite round.

The subsequent operations for finishing the pins,

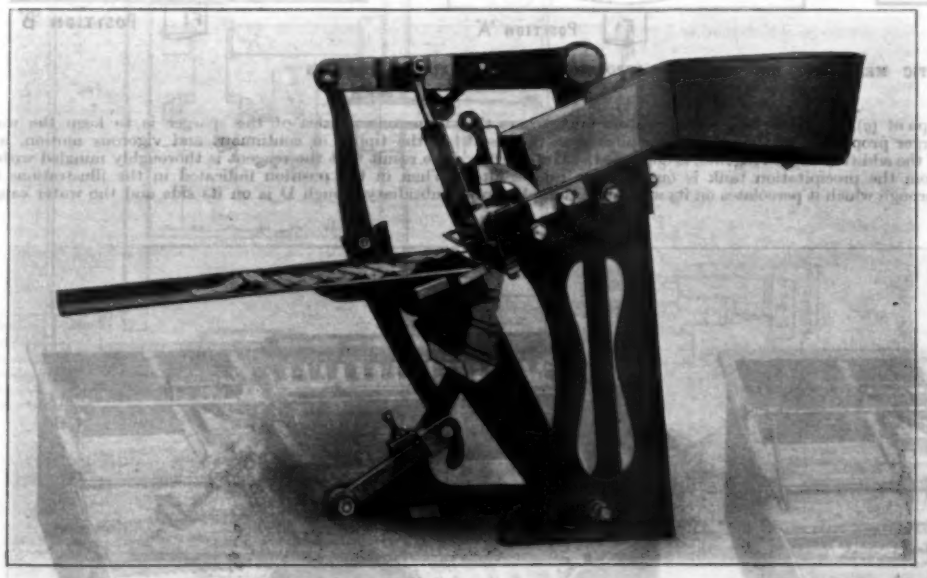


FIG. 119—PIN STICKING MACHINE—E. WHITE

by polishing, tinning and so forth, need not be enlarged upon here; but the machine used for sticking them into paper is worthy of a brief description. It is illustrated in Fig. 119.

The pins are thrown into a hopper, the bottom of which slopes down at the front. Down this slope there are cut a number of slots which have rounded edges at the top, and gradually narrow towards the bottom. The pins slide down the little valleys thus formed, until they hang, caught by their heads, at the lower ends of the slots. There are, of course, as many slots as there are to be pins in each row in the paper. In front of the ends of the slots there is a sliding gate, which can be pulled down by a treadle, and has a thickness equal to the width of the pin heads.

The paper into which the pins are to be stuck is fed upwards from below, between a pair of crimping tools. These tools are arranged just below the points of the pins as they hang in the ends of the slots, and when the moving tool is pushed forward the paper is crimped into a M shape. The gate is then pulled down by the treadle and the pins are driven through the apices of the two crimps, passing through serrations in the edges of the tools, which correspond with the spacing of the slots. The crimping tool is then drawn back, the paper pulled forward and the process repeated.

The small machine seen at the end of the bench in Fig. 117 is used for dressing up the pin-making dies. There is a high-speed spindle for grinding out the hollows, while the driving pulley is faced with emery for trimming up the flats.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

M. BERTIN AND THE JAPANESE NAVY.

SIR,—Will you permit me, for the sake of historical accuracy, to correct certain statements relating to the late Monsieur Bertin which your Paris correspondent makes in French Engineering Notes, published in this week's issue? "M. Bertin," he writes, "was selected by the French Government in 1886 to go to Japan to create a modern navy. He remained in Japan four years, during which time he prepared the designs for the ships and built the fleet which defeated the Chinese Navy in 1891. He also designed and laid out the arsenal of Yokosuka."

The fact is that the creation of a modern Japanese Navy was already in progress when M. Bertin went out to Japan. The foundations had been laid by British naval officers, of whom Captain John Ingles, R.N., was the last; and British shipyards had provided, and continued to provide, the bulk of Japan's naval material. The only ships designed by M. Bertin were the protected cruisers Matsushima, Itsukushima, and Hashidate, of which the first two were built in France and the last named was laid down at Yokosuka. The Japanese fleet which defeated the Chinese force at the Battle of the Yalu in 1894—not 1891—numbered twelve units. Three of these were of French construction and design, six were built in Great Britain, and the remaining three in Japan. Admiral Ito's van squadron at the Yalu comprised three British-built ships and one Japanese, and all accounts agree that the vigorous attack of this squadron gave a decisive turn to the action. The subsequent preference of the Japanese Navy for British designs suggests that the ships built in this country had given complete satisfaction.

Yokosuka Dockyard was laid out as far back as 1865—by a French engineer, it is true—and was already a well-equipped establishment when M. Bertin went out to Japan in 1886. But so far as the ships, the administration and training, and the system of tactics were concerned, the Japanese Navy of 1894 was essentially of British origin, and fairness demands that the fact be recorded. The achievements of the late M. Bertin in other directions were sufficiently brilliant to sustain the high reputation which he enjoyed.

HECTOR C. BYWATER.

Beckenham, November 1st.

STEAM HEATING A HOSPITAL FROM DISTANT STATION.

SIR,—Your correspondent will find very complete details with illustrations of a most successful system of steam heating at a distance of up to three-quarters of a mile, through a tunnel or subway, and for 250 heating days per year, in THE ENGINEER of October 6th (p. 330) and October 13th, 1905 (pp. 353–354). The steam pressure there named (p. 331) is, however, somewhat lower—107 lb. normal to 134 lb. maximum, and is reduced through a valve to 80 lb. before admission to the steam mains. In the coldest weather the temperature rise is as much as + 72 deg. and the heat in buildings then averages 68 deg. Fah. The economy is very considerable over every other system of heating (see col. 2, page 354); but while the steam at 120 lb. (gauge) requires 1191.5 B.Th.U. per pound water, steam of 180 lb. gauge requires 1197.7 B.Th.U. per pound, or only 6 B.Th.U. additional for 50 per cent. pressure increase.

From personal knowledge of the system described, I should be happy to send direct details that may not be found in THE ENGINEER referred to.

CHARLES R. KING.

November 4th.

INTERNATIONAL ROADS CONGRESS.—The annual meeting of the Permanent International Commission of Road Congresses was held at Paris on October 25th, when Great Britain was represented by Mr. C. H. Bressey, Chief Engineer of the Roads Department, Ministry of Transport. By the recent addition of Australia, the Irish Free State and the Government of Northern Ireland, the number of States subscribing to the Association has now reached thirty-nine, while the list of individual and corporate members shows a steady increase. The principal business of the meeting was to discuss the preparations for the next Roads Congress, which is to be held at Milan in the autumn of 1926, at the same time as the annual exhibition. The Congress will open on Monday, September 6th, 1926, and will last the whole of the week. Apart from the papers to be read, the Congress will afford an opportunity of inspecting the great motor road from Milan to the Italian lakes, which is now in course of construction and which is the first example of a motor way reserved, on payment of toll, for mechanically propelled vehicles. For the benefit of English-speaking members a British Organising Committee has been established in London with headquarters at the offices of the Ministry of Transport, 7, Whitehall-gardens, S.W. 1. Any inquiries can be sent to Mr. E. B. Hart, joint honorary secretary, at that address. Agreement has already been reached in most cases as to the engineers to present papers on behalf of Great Britain under the various heads of the agenda. It may be anticipated that British manufacturers of road plant will take advantage of the exhibition which synchronises with the Congress.

Water-softening Plant at Erith.

We were recently invited to inspect in operation a new water-softening plant which the Becco Engineering and Chemical Company, Limited, of 158/160, City-road, London, E.C. 1, installed in March last, at the Albion Works at Erith of the Erith Oil Works, Limited, and by the courtesy of the latter company we are enabled to publish the following description.

It may be explained at the outset that the water treated comes from the mains of the Metropolitan Water Board, and that it has the following average analysis :—

Substance.	Grains per gallon.
Calcium carbonate	16.8
Calcium sulphate	3.5
Calcium nitrate	0.92
Magnesium nitrate	1.10
Sodium nitrate	2.78
Sodium chloride	2.9

Its total hardness is 20.8 and its permanent hardness 4.0. According to some figures with which the chief chemist of the Erith Oil Works, Limited, has been good enough to supply us, the hardness as the result of treatment in the new plant is brought down to 1.5 grains per gallon, as ascertained by the lather test, and we gather that boilers using 1000 tons of water each per week show an increase of concentration of contents of from 50 to 100 grains per gallon in that period—the amount being kept down by blowing out to the extent of 1 per cent. of the feed consumption. The deposit is of a soft nature and easily removed. We are informed that since the new plant was started, both Lancashire and Babcock boilers have been run for continuous periods of 2400 hours without being opened up, and it is considered that they would run quite satisfactorily for 3000 hours without stoppage. The length of time necessary to allow for closing down a boiler, cleaning it out, and putting it into service again has been reduced to seven days.

The apparatus which has effected these improvements is known as the "Becco-Legg" plant, and its arrangement is shown diagrammatically in Fig. 1. It is in duplicate, there being two identical units, each of which is designed to deal with 8000 gallons of water per hour. The combined capacity of the two units is, therefore, 160,000 lb. of water per hour. The softening is effected by the addition of a lime-soda mixture. Briefly described the plant comprises :—(*a*) A reagent tank in which the solution is automatically kept thoroughly stirred ; (*b*) an automatic arrangement by means of which a measured quantity of reagent is lifted from the tank at each stroke of the mechanism and delivered into (*c*) an automatic water-measuring tipper of the over-balancing type, which can be made to deliver a given volume of water with great accuracy, and is furnished with (*d*) a subsidiary trough which is of sufficient capacity to take, while the contents of the measuring tipper is being discharged, the delivery of (*c*) a sparger, which is constantly at work, so that only the measured quantity of water in the tipper is discharged at each stroke of the latter. When the tipper has discharged its contents, it, by its own weight, returns to its original position and the crude water caught in the meanwhile in the subsidiary trough finds its way through a

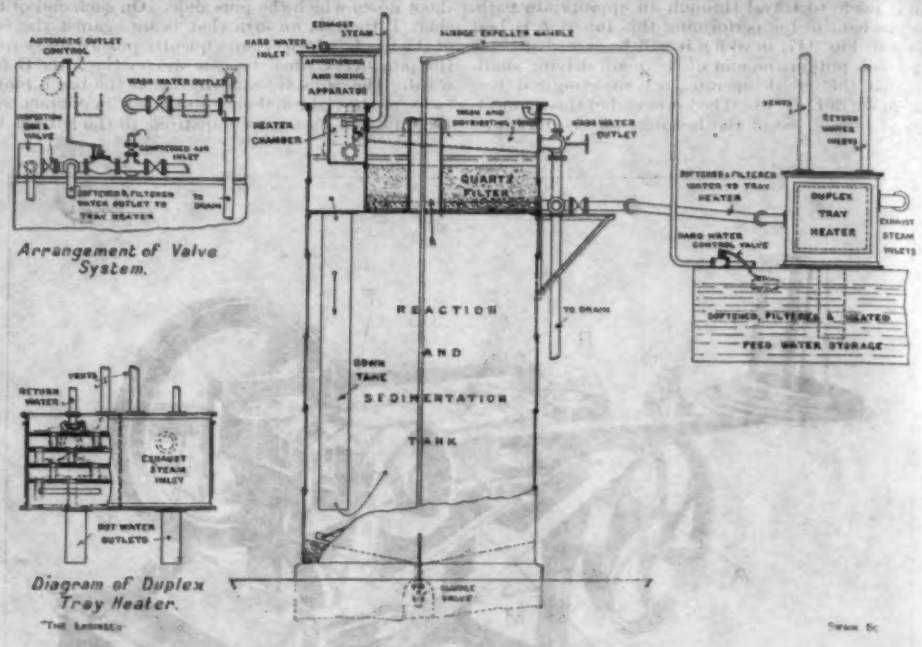
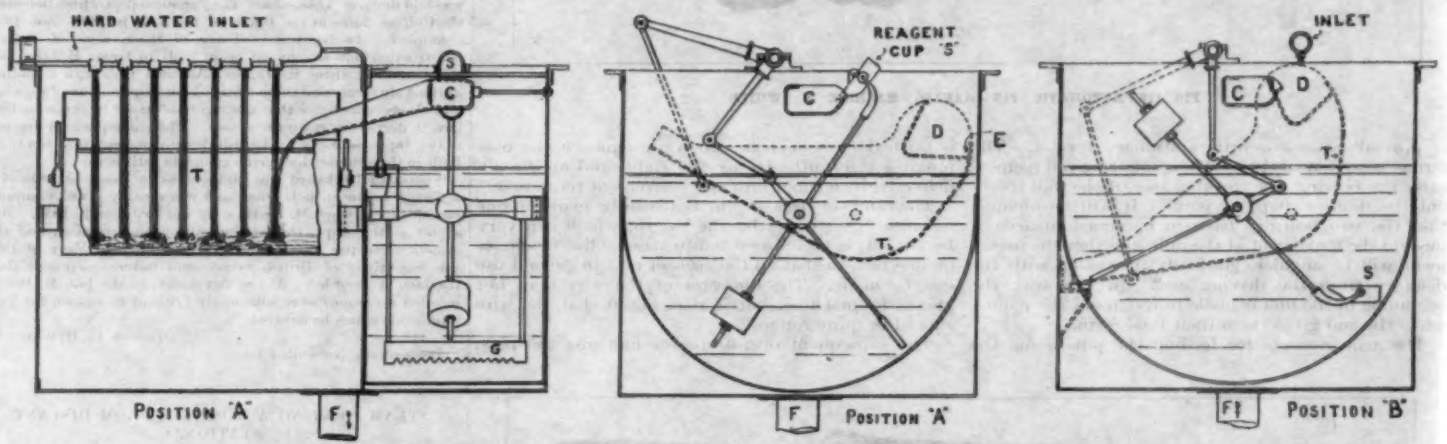


FIG. 1—ARRANGEMENT OF "BECCO-LEGG" WATER-SOFTENING PLANT

pipe of (*g*), a reaction and sedimentation tank, where the larger proportion of the solids, precipitated as the result of the addition of the reagents, is deposited. The overflow from the precipitation tank is on to (*h*), a quartz filter through which it percolates on its way to (*j*), a duplex tray heater, which is supplied with exhaust steam, and thence to (*k*), a softened, filtered and heated feed-water storage tank. The flow of crude water to the whole apparatus is controlled by a valve operated by a float in this storage tank.

We can now proceed to discuss the various portions of the plant in detail. The automatic measuring and reagent apportioning and mixing apparatus is shown in the three diagrams—Figs. 2, 3 and 4, and in the half-tone engravings, Figs. 5 and 6—which are diagrammatic. In Figs. 2, 3 and 5 the tipping trough T is in the position in which it is receiving raw water from the sparger and at the same time its measured charge of reagent through the spout C. The effect of the rush of water through the numerous nozzles of the sparger is to keep the water in the tippar in continuous and vigorous motion, with the result that the reagent is thoroughly mingled with it. When in the position indicated in the illustrations the subsidiary trough D is on its side and the water caught in it has found its way into the main trough T through the slot E. In Fig. 4 the main trough T is shown tipped so that it has discharged its contents into the tank below, and the subsidiary trough is in position to catch the water coming from the sparger. This trough, it may be ex-



FIGS. 2 TO 4—AUTOMATIC MEASURING AND REAGENT APPORTIONING AND MIXING APPARATUS

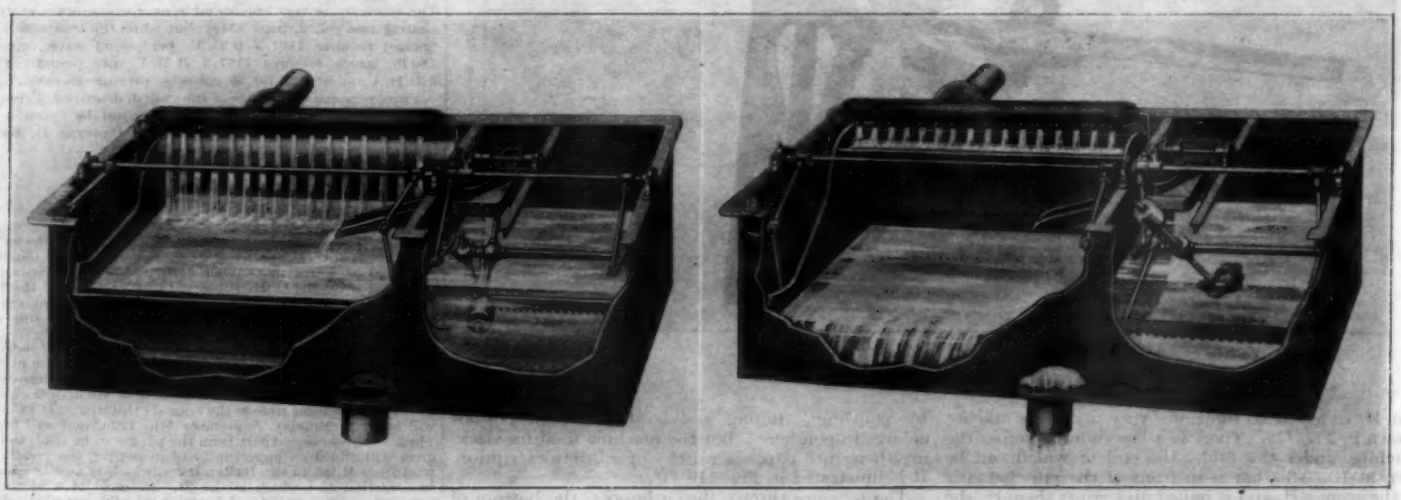


FIG. 5—MEASURING TIPPER BEING FILLED

FIG. 6—MEASURING TIPPER DISCHARGING

plained, is quite large enough to take the whole of the water delivered by the sparger while the tipper is discharging, so that no water passes through without being measured. The reagent tank is furnished with a system of links and levers which perform two definite operations. The first is to swing backwards and forwards through approximately a right angle at each stroke of the apparatus a serrated-edged stirrer G, which keeps the reagent thoroughly mixed, and the second is to lower into the solution a pivoted arm, which is provided at one end with an adjustable weight, and at the other with a measuring cup S, which is carried in gimbals, so that it may always hang horizontally. Both these operations are effected automatically by the motion of the main tipping trough in a manner which is clearly shown in Figs. 5 and 6. As the reagent solution is always maintained at the desired strength for the correct treatment of the particular crude water being supplied to the apparatus, and as the action of the apparatus is such that the cup S is always filled with reagent, and is, at each stroke, made to deliver its contents into the measuring tipper through the channel and spout C, and as the tipper delivers a definite volume of water at each stroke, it follows that the correct amount of reagent to effect the desired softening is mixed with the incoming water.

We believe that it is not essential for the efficient working of the process that the water should be heated subsequently to the addition of the reagent, but exhaust steam happened to be available in the present instance, and it was decided to utilise as much of its heat as possible, the more so as the softened water, as explained above, is, after sedimentation and filtration, and after passing through another heater, fed direct to the boilers. As the flow of the incoming water is controlled by a float-actuated valve, water is only passed through the apparatus when the boiler-feed storage tank is being drawn upon, but whether the water is going in fast or slowly only the required amount of reagent is added to the water, since the whole action of the apparatus is governed by the main tipping trough and only one cupful of reagent is mingled with each discharge from that trough.

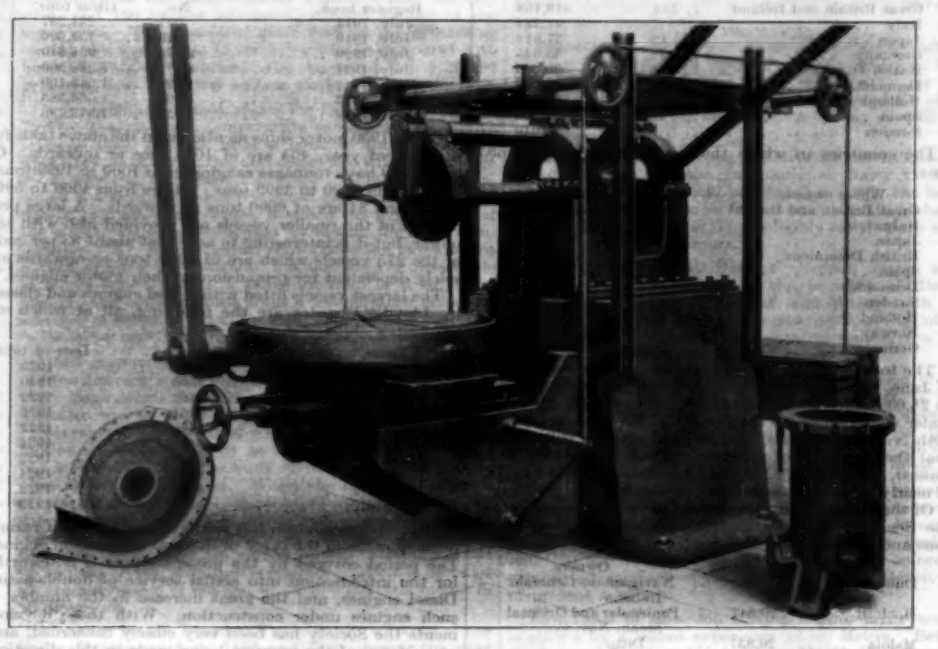
The dosed water after passing through the heater chamber overflows and passes through a circular downtake tube, which descends nearly to the bottom of the sedimentation tank, and it is there that, as has been said, the majority of the suspended matters is deposited. One of the special claims made for the Becco-Legg plant is that the sedimentation tank is amply large for the completion of the chemical reaction and for the deposition of the suspended solids. The overflow from the sedimentation tank is by way of a central tube, which discharges on to the top of the quartz filter, which removes the remainder of the suspended matters so that the softened water as it flows away to the duplex tray heater is quite clear. The filter, it may be explained, is readily cleansed by passing through it a reverse current of wash water—that is making the water flow upwards instead of downwards—preceded by a blast of air from an air compressor. If compressed air be not available, a steam air injector can be used. We observed the washing of a filter and noticed that the washing and putting it back into operation took about a quarter of an hour. In actual service, we understand, the filter has only to be washed about once a week. The sludge which collects in the bottom of the sedimentation tank is discharged at intervals through a valve at the bottom, the action being assisted by a sludge expeller, which scrapes the deposit from the funnel-shaped sides of the bottom of the sedimentation tank, and is operated by a long handle arranged above the top of the tank.

The whole plant is, we understand, from the Erith Oil Works, Limited, working well and giving every satisfaction.

The United States Bureau of Standards has issued in manuscript form a code of instructions entitled "Inspection of Portland Cement," by J. R. Dwyer and Roy N. Young. The document goes much more fully into the technique of cement inspection than do the standard specifications, and includes a fairly full statement of the practice of the Bureau of Standards in cement testing work.

Large Surface Grinding Machine.

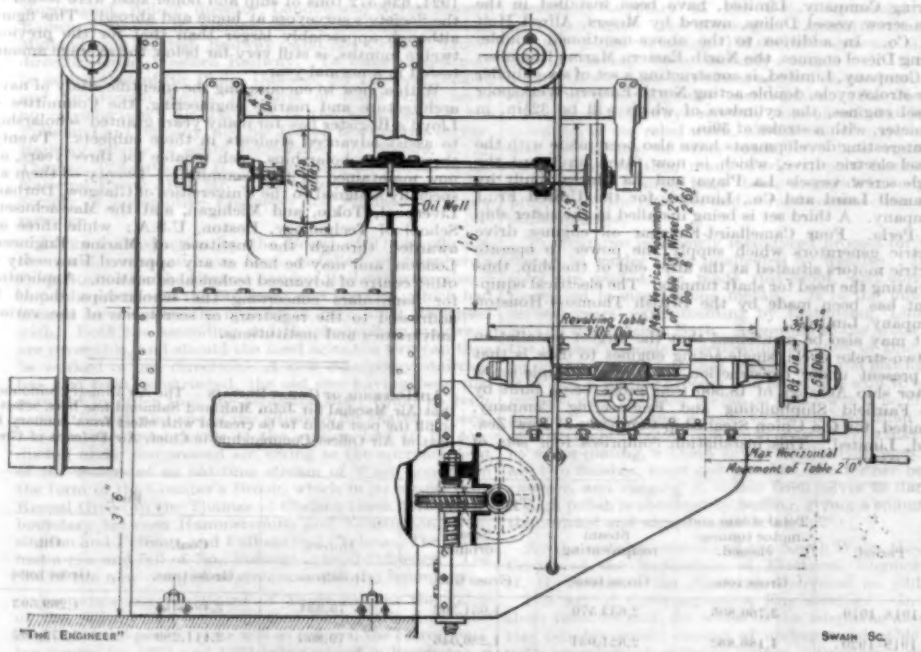
The surface grinding machine illustrated herewith was built by Meldrums, Limited, Timperley, near Manchester, for special duties in the firm's own shops, to the design of Mr. A. B. Scorer, M.I. Mech. E., but would appear to have other and wider applications. The manufacture of acid-resisting chemical apparatus in high silicon iron involves special equipment for the machining of castings made in this material, as the hardness of the metal is of about the same order as that of chilled cast iron. Meldrums, Limited, have developed the manufacture of apparatus in this acid-resisting metal in a number of directions, and were recently called upon to supply some large high-lift centrifugal acid pumps which involved the grinding of castings having a maximum radius of 18in. The surface to be ground was the flanged joint round the periphery of the pump volute, the casing being in halves. Sunk below the level of this facing is another facing against which the impeller has to run with a very small clearance. The usual form of grinding machine for flat surfaces is the face wheel type, having either a vertical spindle or a horizontal spindle with a large diameter wheel composed of emery blocks. Neither form of these machines is suitable for the purpose referred to as the sunk facing could not be ground on it.



SPECIAL SURFACE GRINDING MACHINE

As will be seen, the machine designed to grind the castings comprises three essential parts:—(*a*) A bed on which is a vertical slide for (*b*) the bracket which carries the table; and (*c*) a headstock for carrying the abrasive wheel spindle. The table is 36in. in diameter, but is capable of taking overhanging work up to 4ft. 6in. diameter. It is caused to revolve slowly by a worm and worm wheel driven by a two-speed cone and belt, and is mounted upon a compound slide rest, the whole being carried on a bracket which is almost balanced by means of weights suspended on wire ropes carried over the top of the machine. Vertical movement of the bracket is effected by means of the hand wheel, worm, worm wheel and screw shown in the sectional drawing. The slide which moves the table in line with the machine spindle will traverse from the centre of the table to the outside of a diameter of 46in. The slide at right angles has a traverse of 20in. The grinding spindle is fitted with two self-oiling bearings, 2½in. by 9in., having cast iron bushes, a ball bearing at the end of the extension sleeve, and an outer ball bearing. The latter bearing is carried by a massive cast iron tube supported on the bearing housing. The whole of the bearing housing is movable so that a considerable amount of adjustment is possible for articles of a large diameter. A rise and fall on the table of 28in. is obtainable.

The machine has been found of considerable service on cast iron parts, for which purpose it has proved more efficient than planing. Owing to the massive nature of all parts and the large belt power provided, the machine has a great productive capacity. When fitted with a 16in. diameter "Vitrite" grinding wheel it was found possible on ordinary cast iron to remove 98 cubic inches of metal per hour, without appreciable wear, after several hours' work at this rate. By tilting the rests carrying the circular table work can be ground concave or convex at will.



SURFACE GRINDING MACHINE FOR PUMP CASINGS

Lloyd's Register of Shipping.

ANNUAL REPORT.

The annual report of Lloyd's Register of Shipping has just been published, and, since it is too long to reprint in full, we follow our usual custom of abstracting those portions of it which are most likely to prove of greatest interest to our readers.

At the outset it is explained that the operations of the Society during the twelve months ended June 30th, 1924, continued to be adversely affected by the persistent depression in the shipbuilding industry, which has been a prominent feature of its annual reports for three years past. The tonnage of new vessels classed by the Society during the year—July, 1923, to June, 1924—constitutes the lowest record over fifteen years, with the exception of the second year of the war, and represents only 55 per cent. of the total for 1922–23; only 35 per cent. of that for 1921–22; and only 27 per cent. of that for 1920–21.

Whether the bottom of the curve has yet been reached it is impossible to say, but a number of points will necessarily occur to anyone in search of enlightenment upon the subject. Amongst these may be mentioned the fact that during the year ended June last, 454 vessels, of 600,595 tons gross, were lost, and some 500 vessels, of about 1,250,000 tons, were dismantled or broken up, the last figure being exactly twice that—625,000 tons—of the vessels dismantled or broken up during the twelve months ended June, 1923. It is true that, notwithstanding this removal of more than 1¾ millions of tons of shipping, the mercantile fleet of the world is even now greater by about 15 millions of tons than it was in 1914; but, on the other hand, it is well recognised that there is a large proportion of the laid-up tonnage which is unlikely ever to be able successfully to seek for employment. It has also to be borne in mind that any serious revival in overseas traffic will probably lead to the further elimination of uneconomical tonnage, some of which is still in service. Shipowners are fully alive to the necessity—in the gradual return to more normal conditions, slow though it has been up to the present time—of providing themselves with up-to-date fleets, and they are aware that shipbuilders, in the circumstances now existing, are prepared to make extraordinary efforts to meet them, so that some of the vacant berths in the shipbuilding yards may be occupied. Moreover, there were at the end of June last 461 vessels, of 1,641,246 tons gross, actually being built throughout the world under the special survey of Lloyd's Register, with a view to classification in the Society's register book. This tonnage shows a considerable increase on the similar figure for June, 1923, but it would be unwise to attach too much importance to the fact, as it appears that, while several orders for passenger liners and vessels for special

trades have been placed, few inquiries are being made for cargo vessels of ordinary types.

The figures of new vessels to which the Committee of Lloyd's Register assigned classes during the twelve months ended June 30th, 1924, show a total of 371 vessels, of 885,660 tons gross. During the year plans for 489 vessels, of 1,308,845 tons, were passed by the Society. These figures are appreciably in excess of those for 1922–23, but they are again far below the average for several years previous to the war, and it does not necessarily follow that all the proposed ships will actually be built.

The countries in which the greater part of the new tonnage classed by Lloyd's Register during the year has been constructed are shown in the following statement :—

Where built.	No.	Gross tons.
Great Britain and Ireland	252	619,158
Italy	7	41,484
Japan	10	37,612
Germany	12	35,035
British Dominions	15	29,620
Denmark	12	29,269
Holland	25	25,004
Spain	14	22,338
Sweden	6	20,010

The countries in which the vessels are chiefly owned are :—

Where owned.	No.	Gross tons.
Great Britain and Ireland	230	604,694
Italy	7	41,484
Japan	9	37,223
British Dominions	22	33,211
Spain	17	32,600
Denmark	11	26,303
Sweden	8	22,059
Holland	12	19,844
Norway	6	18,855
Germany	3	14,288

The total tonnage of merchant vessels afloat at the end of June, 1924, holding the Society's classification amounts to 28,030,353 tons. If to that figure be added the vessels under construction to the Society's classification on June 30th, viz., 461 vessels, of 1,641,246 tons, it will be seen that the aggregate of shipping classed, or intended to be classed, with Lloyd's Register amounts to 10,159 vessels of nearly 30 million tons gross.

Of the vessels built during the year which have received the Society's classification, the following are of 10,000 tons and upwards, viz.:—

Name.	Gross tons.	Owners.
Duilio	23,228	Navigazione Generale Italiana
Mooltan	20,847	Peninsular and Oriental Steam Nav. Co.
Maloja	20,837	Ditto
Cristóbal Colón	10,833	Cia. Trasatlantica
Alfonso XIII.	10,551	Ditto
Hakusan Maru	10,380	Nippon Yusen Kaisha
Tilawa	10,006	British India Steam Nav. Co., Ltd.
Talma	10,000	Ditto

Steam turbines were fitted in 11 new vessels, of 99,464 tons gross. Four of these vessels exceed 10,000 tons each, and, with the exception of the ss. Duilio (23,228 tons), the turbines are in all cases used in conjunction with reduction gearing, the single-reduction type predominating. The Isherwood longitudinal framing system of construction was adopted in the case of 15 vessels, of 70,930 tons gross, built under the Society's survey during the year. Of these, 9 vessels, of 48,971 tons, are intended for the carriage of oil in bulk. The total number of vessels of all types of construction intended for bulk oil carrying —excluding those of less than 1000 tons—built to the Society's classification during the last twelve months amounted to 18, of 82,706 tons gross. This tonnage is less than 10 per cent. of the total tonnage built to class during the period in question, and compares with 348,565 tons in the year 1922–23, which represented 21 per cent. of the total tonnage classed. The following figures of all oil-carrying vessels recorded in Lloyd's register book for the years mentioned throw an interesting light on the trend of the demand for such vessels :—

Register book.	Oil tankers. (Steamers and motor ships.) Gross tons.
July, 1914	1,478,988
July, 1919	2,929,113
July, 1920	3,354,314
July, 1921	4,418,688
July, 1922	5,062,699
July, 1923	5,203,601
July, 1924	5,243,238

During the year, 45 vessels, of 242,162 tons—27.3 per cent. of the total tonnage of new vessels classed—were fitted for burning oil fuel for steam raising. The following table, comprising all such steamers recorded in Lloyd's register book, shows the gross tonnage of vessels either originally fitted to burn oil fuel or subsequently converted for that purpose. The figures for 1914 are given for comparison with those for the post-war years.

Register book.	Steamers fitted for burning oil fuel. Gross tons.
July, 1914	1,310,209
July, 1919	5,336,678
July, 1920	9,359,334
July, 1921	12,796,635
July, 1922	14,464,162
July, 1923	15,792,418
July, 1924	17,154,072

These figures refer to vessels which are fitted with installations for burning oil in the furnaces of their boilers, but it must not necessarily be assumed that all these vessels are using oil. It will be understood that a number of such installations can readily be replaced on occasion by coal-burning fittings when oil is unobtainable or when its price, compared with coal, is so great as to render its use unprofitable.

Among other types of vessels classed during the year were various tugs, dredgers, fishing vessels, ferry boats, non-propelling barges, &c., for river and harbour purposes, a cable vessel, and forty yachts. As was the case in the previous twelve months, no sailing vessels depending solely upon wind power for propulsion (other than yachts) were submitted for classification by the Society.

Vessels fitted with oil engines to which classes have been assigned by the Committee during the year numbered 62, of 163,795 tons, 12 of which, totalling 74,041 gross tons, were ships of more than 5000 tons each. Heavy oil is used in all these engines. Included among these ships are 30 vessels, of 98,022 tons gross, built in Great Britain and Ireland, of which 7, of 6261 tons gross, are owned abroad. In addition, other motors, using petrol, paraffin, &c., were fitted in 11 small vessels, of 541 tons gross, which were classed by the Society during the same period.

The steady increase in the use of the internal combustion engine for marine purposes is clearly shown by the following figures of all vessels fitted with this type of machinery, as recorded in successive editions of Lloyd's register book, excluding those of less than 100 tons :—

	Motor ships.	
Register book.	No.	Gross tons.
July, 1914	297	234,287
July, 1919	912	752,606
July, 1920	1,178	955,810
July, 1921	1,473	1,248,800
July, 1922	1,620	1,542,160
July, 1923	1,795	1,666,385
July, 1924	1,950	1,975,798

Of the 1950 motor ships mentioned in the above table for the current year, 405 are of 1000 tons or upwards. Of these, 130 have tonnages ranging from 1000 to 1999 tons ; 97 are from 2000 to 3999 tons ; 94 are from 4000 to 5999 tons ; and 84 are of 6000 tons or upwards. A large proportion of the smaller vessels are provided also with sail power, but it is interesting to note that about 83 per cent. of the 275 vessels which are of 2000 tons or upwards are solely dependent for propulsion on their motor engines.

The largest vessels fitted with Diesel engines and classed by Lloyd's Register are the following, all of which are twin-screw ships :—

Name.	Gross tons.	Date of build.
Glenogle	9513	1920
Glenapp	9503	1920
Lochgoil	9462	1922
Glenbeg	9461	1922
Glengarry	9460	1922
Glenshiel	9415	1924
Lochkatrine	9409	1922
Lochmonar	9403	1924
Dinteldijk	9389	1922
Drechtdijk	9338	1923

Mention was made in last year's annual report of various developments in the types of internal combustion engines. The period covered by the present report is noteworthy for the introduction into actual service of double-acting Diesel engines, and the great increase in the number of such engines under construction. With these developments the Society has been very closely concerned, and, as evidence of the progress being made in this direction, some examples may be quoted of various types of such double-acting engines which are being built under the superintendence of the Society's surveyors. Of these, the construction of the two six-cylinder, four-stroke cycle, double-acting Diesel engines being made by Messrs. Burmeister and Wain, of Copenhagen, for a twin-screw passenger vessel being built by Sir W. G. Armstrong, Whitworth and Co., Limited, for the Swedish American Line, has been further advanced. The three-cylinder, two-stroke cycle, double-acting Diesel engine built by the North British Diesel Engine Works (1922), Limited, has been installed in the single-screw vessel Swanley, owned by Harris and Dixon, Limited. This is the first two-stroke cycle, double-acting engine of British manufacture to be fitted on board ship. The "Scott-Still" combined oil and steam engines, built by Scotts' Shipbuilding and Engineering Company, Limited, have been installed in the twin-screw vessel Dolius, owned by Messrs. Alfred Holt and Co. In addition to the above-mentioned double-acting Diesel engines, the North-Eastern Marine Engineering Company, Limited, is constructing a set of six-cylinder four-stroke cycle, double-acting North-Eastern-Werkspoor Diesel engines, the cylinders of which will be 32½in. in diameter, with a stroke of 59in.

Interesting developments have also been made with the Diesel-electric drive, which is now fitted on board the single-screw vessels La Playa and La Marca, built by Cammell Laird and Co., Limited, for the United Fruit Company. A third set is being installed in the sister ship La Perla. Four Camellaird-Fullagar oil engines drive electric generators which supply the power to operate electric motors situated at the after end of the ship, thus obviating the need for shaft tunnels. The electrical equipment has been made by the British Thomson-Houston Company, Limited.

It may also be mentioned that the largest installation of two-stroke cycle, single-acting engines to date is that at present under construction for the quadruple-screw motor ship Aorangi, of 18,500 tons gross, being built by the Fairfield Shipbuilding and Engineering Company, Limited, for the Union Steamship Company of New Zealand, Limited. This installation comprises four sets of six-cylinder, two-stroke cycle, single-acting Diesel engines of Fairfield-Sulzer type.

The above table, compiled from the Society's records, is of considerable interest, as showing, for vessels built to the Society's class during the last six years, the relative proportions fitted of (i) reciprocating steam engines ; (ii) steam turbines ; and (iii) motors ; and also for the same period the proportion of the tonnage built to be propelled by the medium of (*a*) coal only, and (*b*) oil, i.e., as fuel for boilers or for motors. (A number of these vessels can, of course, burn either coal or oil for steam-raising.)

Period.	Total steam and motor tonnage classed.	Type of engines.			Fuel.	
		Steam reciprocating.	Steam turbines.	Motors.	Coal.	Oil.
	Gross tons.	Gross tons.	Gross tons.	Gross tons.	Gross tons.	Gross tons.
1918–1919	3,760,806	2,633,570	1,051,302	75,934	2,491,213	1,269,593
1919–1920	4,186,882	2,821,031	1,286,046 (All geared)	79,805	2,111,289	2,075,593
1920–1921	3,229,188	2,373,007	754,513 (All geared)	101,668	1,260,465	1,968,723
1921–1922	2,517,513	1,420,924	870,037 (All geared)	226,552	895,032	1,622,481
1922–1923	1,610,624	842,358	603,037 (All geared)	165,229	662,565	948,059
1923–1924	874,651	610,851	99,464 (All geared but one)	164,336	468,153	406,498

Figures are likewise given below of all the vessels of 100 tons gross and upwards, as recorded in the 1924–25 edition of Lloyd's register book, falling within the above categories, viz.:—

Total steam and motor tonnage	61,514,140 tons gross
Type of engines—	
Steam reciprocating	50,742,758 "
Steam turbines	8,795,584 "
Motors	1,975,798 "
Fuel—	
Coal only	42,384,270 "
Oil (including steamers capable of burning either coal or oil)	19,129,870 "

The following countries now recognise the surveys and certificates of Lloyd's Register as exempting vessels from undergoing Government inspections of various kinds, viz.:—France, Holland, Norway, Sweden, Denmark, Spain, Greece, Belgium, Portugal, Latvia, and the British Dominions. The Committee is glad to know that the owners of vessels belonging or trading to these countries are saved much inconvenience and delay by official recognition being thus extended to the Society's classification and surveys.

During the last twelve months, refrigerating installations were fitted, under the Society's superintendence, in 18 new vessels, representing a capacity of nearly 4,000,000 cubic feet. With this addition, at the end of June, 1924, the Society's refrigerating machinery certificate (Lloyd's R.M.C.), was held by 323 vessels, with upwards of 65,500,000 cubic feet of insulated space. There are, moreover, at present under construction, or being fitted out, under the inspection of the Society's surveyors, 24 vessels with refrigerating installations, while a number of vessels, already built, are being equipped with refrigerating machinery and insulation under the supervision of the Society's surveyors. In several cases, vessels fitted with refrigerating machinery and insulated cargo chambers are having their installations extended. During the year the Society's surveyors have held, at loading and discharging ports, 2023 surveys on vessels fitted with refrigerating machinery.

In view of the importance and increasing use of direction-finding apparatus in conjunction with wireless telegraphy installations on board ship, the Committee has decided to amplify the existing record in the register book of vessels fitted with wireless telegraphy by making a notation of "Wireless D.F." against the names of those vessels which are equipped with wireless direction finders.

During the year 1923–24 freeboards were assigned to 456 vessels. The number of vessels to which the Committee of Lloyd's Register has assigned freeboards, under the Merchant Shipping Act, 1894, now reaches a total of 23,813. The chain cable tested during the year under the Anchors and Chain Cables Act, 1899, at the eight public proving houses in Great Britain, all of which are under the superintendence of the Committee of Lloyd's Register, amounted to 200,642 fathoms, weighing 13,471 tons. In addition, a quantity of miscellaneous chains and samples was also tested. The total number of anchors tested was 3833, with a gross weight of 4673 tons ; of them, 2426 were stockless anchors, weighing 3940 tons. The diameter of the largest cable tested during the period was 3¾in.; the heaviest anchor tested was a stockless anchor weighing 15 tons 11 cwt. During the year ended June 30th, 1924, 636,572 tons of ship and boiler steel were tested by the Society's surveyors at home and abroad. This figure, although appreciably larger than that for the previous twelve months, is still very far below the average amount tested in a normal year.

With a view to encouraging the scientific study of naval architecture and marine engineering, the Committee of Lloyd's Register has for many years granted scholarships to assist advanced students in these subjects. Twenty-three such scholarships, each tenable for three years, are now maintained by the Committee. Twenty of them are specially assigned to the Universities of Glasgow, Durham, Liverpool, Tokio, and Michigan, and the Massachusetts School of Technology, Boston, U.S.A.; while three are awarded through the Institute of Marine Engineers, London, and may be held at any approved University or other centre of advanced technical education. Application for particulars concerning the scholarships should be addressed to the registrars or secretaries of the various universities and institutions.

AIR DEFENCE OF GREAT BRITAIN.—The Air Ministry announces that Air Marshal Sir John Maitland Salmond has been selected to fill the post about to be created with effect from January 1st next of Air Officer Commanding-in-Chief, Air Defence of Great Britain. The command to which Sir John Salmond has been appointed is a new one, instituted in consequence of the scheme for the defence of the United Kingdom against air attack, which was approved by his Majesty's Government last year. That scheme embraces the formation of fifty-two squadrons as a home defence force, together with the necessary ground defences to be provided by the Army, consisting of anti-aircraft batteries, searchlights, &c.

Railway Matters.

DURING the year 1923 the British railway companies completely renewed 248 locomotives, of which 6 were on the Southern, 46 on the Great Western, 64 on the London, Midland and Scottish, and 126 on the London and North-Eastern Railways. Of their total of 23,870 locomotives 4039 were undergoing or awaiting repairs at the end of the year.

THE London and North-Eastern Railway Company has been standardising the equipment used by its men. Among the items are coupling poles and brake sticks. Before settling on the standard designs for these tools the company arranged for trials, by the men themselves, of various types, and on the results, when agreed to by the men and the company's officers, the standard patterns have been decided.

THE amount of coal consumed per engine mile by the locomotives in this country last year was 49.21 lb. in passenger service, 64.96 lb. in goods service, 41.86 lb. in shunting engines and 54.85 lb. in all services. The London, Midland and Scottish figures were 52.21, 67.44, 47.94 and 58.61 respectively; the London and North-Eastern were 52.72, 68.79, 42.69 and 58.05 respectively. The pints of lubricating oil used per 100 miles for all railways were:—In passenger service, 6.73; in goods service, 7.22; in shunting, 5.61; and in all services, 6.78. The London, Midland and Scottish consumption were 6.53, 6.81, 6.36 and 6.64 respectively; whilst those of the London and North-Eastern were 7.04, 7.72, 4.97 and 7.22.

THE annual reports of the railway companies, in accordance with the Act of 1911, give the number of railway-owned wagons:—(*a*) Completely renewed; (*b*) partially renewed; (*c*) received heavy repairs; and (*d*) received light repairs. There is no corresponding entry as to partial renewals for carriages, and the explanation for the absence would appear to lie in the footnote to table C of the statistical returns in the Railway Returns for 1923. This note says:—"It is understood that, for the purposes of this table, the general practice of the railway companies has been to return as partial renewals only wagons entirely reconstructed, partly with old material and partly with new." Obviously no old material would be employed in the reconstruction of passenger vehicles.

THERE has just been issued the report by Lieut.-Colonel Mount on the derailment of June 28th, at Buddon, on the Dundee and Arbroath Joint Line, of the first portion of one of the East Coast night expresses from King's Cross. It sometimes occurs that no definite cause for the mishap can be found. Various propositions—defective road, failure of the equipment, an obstruction on the track, points damaged, excessive speed—were put forward, but all were dismissed. The accident did, however, afford "another example of the efficacy of Pullman vestibules and Buckeye couples in keeping vehicles upright and in alignment after derailment at high speed." It may be remembered, we would add, that these features have now been incorporated in the Great Western corridor rolling stock.

RAILWAY interests will be represented in the new Parliament by the following members:—Sir Evelyn Cecil, director, Southern Railway; Sir Robert Horne, director, Great Western Railway; Major David Davies, director, Great Western Railway; Major-General Sir Frederick Sykes, director, London Electric Railways; Lieut.-Colonel Murrough J. Wilson, director, London and North-Eastern Railway; Mr. E. B. Fielden, deputy-chairman, London, Midland and Scottish Railway; and Mr. Cyril E. Lloyd, director, Great Western Railway. To these names may be added that of Sir Philip Dawson, Sir Davison Dalziel, and Sir Joseph Neill. The first of these three needs no introduction; Sir Davison is the chairman of the Pullman Car Company, and Sir Joseph is a railway carrier. Railway labour is again represented by Messrs. J. H. Thomas, T. Louth and H. C. Charleton, all officers of the National Union; but Mr. J. Bromley, of the Associated Society of Locomotive Engineers and Firemen, is a new member.

AFTER an inspection by the Board of Trade officials, the escalators that have been installed at Shepherd's Bush Station on the Central London Railway were placed in public service on the 5th inst., and the lifts, which had been in service since the opening in July, 1900, dispensed with. Both the ascending and the descending stairways are reversible, and should the need arise the two can thus be worked in one direction. A new emergency staircase has also been constructed, the old one having been dismantled in order that the escalator shaft could be built across the well and one of the adjacent lift shafts. Operations in the lower levels of the station had to be conducted under compressed air, owing to the encroachment of the waters of an old-time stream of West London in the form of the Counter's Brook, which in its course from Kensal Green to the Thames at Chelsea Creek formed the boundary between Hammersmith and Kensington, Kensington and Fulham, and Fulham and Chelsea. The water had a rise and fall of 7in., indicating tidal influence. The line of the new covered-in stream is still the boundary.

ACCORDING to the Board of Trade returns the value of the railway material exported during the first nine months of the present year was as follows, the corresponding figures for 1923 and 1922 being added in brackets:—Locomotives, £1,491,348 (£2,117,597, £3,783,202); rails, £1,273,257 (£1,876,411, £1,950,135); carriages, £877,147 £770,698, £1,306,345); wagons, £2,574,954 (£2,272,359, (£2,587,740); wheels and axles, £446,453 (£724,174, £985,356); tires and axles, £474,322 (£455,302, £328,363); chairs and metal sleepers, £959,805 (£734,489, £1,601,251); miscellaneous permanent way, £853,700 (£838,153, £1,087,939); total permanent way, £4,170,371 (£4,885,077, £6,154,383). The weight of the rails exported was 138,169 tons (208,780 tons, 193,020 tons), and of the chairs and metal sleepers, 76,242 tons (64,337 tons, 117,916 tons). During the month of September last locomotives of the values indicated were shipped to the following countries:—India, £5136; Australia, £2032; South America, £23,813; Europe, £41,872; and rails to:—West Africa, £4326; New Zealand, £12,000; India, £16,480; the Argentine, £23,377.

Notes and Memoranda.

THE Swedish firm, Uddeholms Limited, is experimenting with a new method in the production of steel, invented by an engineer named Flodin. The method is said to involve a saving of 50 per cent. of the cost. The report is confirmed by the head of the company, M. Herlenius, but no details are given.

THE supply of electrical power for industrial purposes is being extended in Auckland, where there are 5000 consumers. There has been an increase during the present year, representing an annual gain of over 200 industrial consumers on the direct-current system within the city area, and 150 on the alternating-current supply in the outer area. The maximum peak load on the generating station this winter was 15,000 kilowatts, as compared with 8000 kilowatts last winter. The Auckland Power Board generates over 1,000,000 units a week.

IT is a well-known fact, states the *Iron and Coal Trades' Review*, that at room temperature some quenched alloys increase their strength after a lapse of time, extending over a few days or months, and associated with this change other physical properties also vary. This phenomenon, which is attributed to some internal change going on very slowly at room temperature, is called the aging effect of the alloys, which is accelerated by raising the room temperature. Mr. Isamu Igarusi shows that the aging is not a very unusual phenomenon, but one always observable in alloys which possess a transformation or a eutectoid change, and are quenched from a temperature above it, and also in alloys in which the solubility of one component in the other rapidly increases with the rise of temperature.

VERY gradual heating and cooling of pure copper in an electric furnace is the secret of the success in producing very large single crystals, and crystals up to 3in. in diameter by 6in. long have been produced in this way. If a crystal about the size of a lead pencil is given a jerking motion, it bends as easily as does a stick of soft wax; but it cannot be bent back any more easily than a similar piece of ordinary copper. When the copper is a single crystal all of the atoms are arranged in columns, equally spaced. When the bar is bent, the spacing is changed; the atoms on the inside curve are pressed together, and those on the outside are spread apart. Strains are set up and the crystal structure is altered. The bar becomes an ordinary piece of copper, of smaller crystals facing in all directions.

A REPORT by the Board of Trade on the working of the Boiler Explosions Acts, 1882 and 1890, during the year 1923, states that forty-six preliminary inquiries and two formal investigations were held respecting boiler explosions which occurred during that year. Of these forty-eight explosions, thirty-three resulted in loss of life or personal injury, ten persons being killed and forty-two injured. The ten deaths were caused by eight explosions, of which seven occurred on land and one in a ship. The number of persons killed and injured during the year is below the respective average (23.71 and 54.31) for the 41¼ years since the Act of 1882 came into force, and below the number of persons killed (eleven), but above the number of persons injured (twenty-eight) during the year ended December 31st, 1922.

NORWAY has been solving the problem of unemployment by appropriating funds for productive work, thereby utilising labour otherwise idle, says a report from A. E. Fenselau, Secretary to the U.S. Commercial Attaché at Copenhagen. The Norwegian Legislature has appropriated funds totalling 180,000,000 crowns, 5,000,000 crowns having been recently voted. Of the total, 140,000,000 crowns have been applied on productive work, much of it on highway construction. The Norwegian Director of Highways recently announced that since the inception of the relief work, 450 kiloms. of main highways and 250 kiloms. of other roads have been constructed. In addition to this, many workers, paid from the unemployment grants, have been engaged in emergency projects for the railways and in road construction work for municipalities.

PLATINISING is a newly introduced process for treating metals to render them unaffected by weather. Iron and steel are said to be made rust-proof, and corrosion is prevented in non-ferrous metals. It is the outcome of several years' experimenting by Platinising, Limited, of 21, Old Bond-street, Bath. According to the *Motor Trader*, the process consists of depositing an alloy of zinc to form an impervious coating that takes a high and lasting polish. It is not a plating process, for the zinc is said to be incorporated with the basic metal, so that there is no chance of peeling. Platinising is said to be cheaper than electro-plating, and the colour and finish are similar to that secured by silver-plating, without any of its disadvantages. There are two finishes, matt and polished, the former being the cheaper, and ranging in colour from silver to dark grey. A high polish is obtained by buffing, giving a colour whiter than nickel and almost equal to silver.

AT the opening meeting of the North Wales (Liverpool) Centre of the Institution of Electrical Engineers, Mr. H. H. Harrison, the chairman, delivered an address on "The Art of Communication Engineering." In a very short time, he said, the whole of the telephone network of this country would consist of underground cable loaded with repeaters at suitable points. Telephone repeaters had always been the dream of the communication engineer. A great deal of work had been done during the past twenty years, but it was not until the advent of the thermionic valve that any real advance was made. One of the most interesting instances of the use of repeaters combined with loading was on the submarine cable links between Key West and Havana, Cuba, laid across the Florida Straits. The three cables were roughly 100 miles long, and were submerged at a depth of 1000 fathoms, the greatest depth at which any telephone cable so far had been laid. They were designed to serve as links between Havana and points in Cuba and New York and Chicago, situated at 1557 and 2453 miles from Key West. On account of the great depth of submersion, single-core cables were used, and the loading consisted of a single layer of iron wire 8 mills. in diameter and making 100 turns to the inch.

Miscellanea.

THE Margahao electric power plant, the largest generating station in New Zealand, was officially opened by Mr. Massey, the Prime Minister, on the 3rd inst.

IT is reported that a rich coalfield has been discovered in the vicinity of Madrid. If the quality of the coal is found to be good it is intended to erect a power station in the region for the supply of electricity to the capital.

THE sixth British Industries Fair (Birmingham) will take place from February 16th to 27th, 1925, and will again be housed in the permanent exhibition buildings at Castle Bromwich, in which there are over 170,000 square feet of floor available.

SENATORE MARCONI has returned to London after an absence of about three months, during which time he has been further developing his new beam system. He is now able to state that this system will be effective for efficient telegraph service over any distance by day as well as by night.

THE oldest electric truck in active service in Chicago is being operated by the International Dairy Company. This light delivery truck, purchased in 1909, has been in continuous daily service ever since. In all probability this truck will continue to give highly satisfactory service for at least five years more.

THE Carlisle Rural District Council, under a new scheme, proposes to supply the parishes of Dalston, Cuton, St. Cuthbert's Without, and Wreay with water from a disused lead mine at Roughtongell, in the Coldbeck Fells. Notwithstanding its unusual source, the water has been certified to be of great purity.

IN his presidential address to the Institution of Electrical Engineers (Sheffield Sub-Centre), Mr. D. G. Jones paid tribute to the work of Dr. Wall and his assistants, who were unremittingly engaged in pursuit of the, at present, elusive secret of freeing atomic energy. He wished them a happy and successful ending to their quest.

IN the course of his presidential address at the congress of the Australasian Association for the Advancement of Science, Sir John Monash said that Australian investment in electrical transmission had been relatively negligible and that much research should be carried out before they committed themselves deeply to a more extensive use of present methods.

THE value of direction finding during foggy weather is shown by a recent experience of ss. Melita. Between Quebec and Newfoundland she ran into a dense fog along with another vessel making for the same port, but not fitted with direction finding apparatus. The Melita, however, was able to determine both her own position and that of the other vessel, and to give the latter her bearings. When the fog lifted the readings on the direction finder were found to be correct.

SURVEYS have been started in Brussels, Belgium, for the construction of a subway. According to an announcement by M. Max, bourgomaster, it is proposed to run the subway from the Gare du Midi to the Putterie quarter, where the central station will occupy a site originally intended for the union railway station, thus making use of some work already completed. From this central point lines will radiate to the other two principal railway stations of the city, the Gare du Nord and the Gare du Luxembourg.

THE two new pits which are approaching completion in the new Campine coalfield of Belgium by the Société Liegois-en-Campine are being electrically equipped. The shafts are each being provided with two separate electrically operated winding engines, each capable of raising about 47 cwt. of coal at a speed of 65.6ft. per second. The capacity of each engine is 150 tons per hour, and as they are intended to work two shifts of eight hours, the four engines will be capable of raising a total of 9600 tons of coal per day.

THE Birmingham Branch of the Electrical Contractors' Association has written to Dr. Innes, chief education officer for Birmingham, with regard to recent contracts placed for the electric lighting of schools. As Government grants have been obtained for this work for the benefit of the unemployed in Birmingham, it is argued that these contracts should not be given to firms outside the city which employ their regular men as foremen and buy a quantity of the material outside. Moreover, the profit does not remain in the city. Dr. Innes states that there is nothing in the conditions of the Unemployment Grants Committee insisting on the restriction of the work to local firms.

IN a report to the Hackney Borough Council the Works Committee records that in September, 1922, the Council adopted a report recommending the acceptance of a quotation of Richard Garrett and Sons, Limited, for the supply of twenty electric vehicles. In order to complete the scheme originally sanctioned by the Council and to ensure the success of the collection during the period of maximum collection, viz., the winter months, the Committee is strongly of opinion that orders should at once be placed with (*a*) Richard Garrett and Sons, Limited, for the supply and delivery of the three additional electric vehicles, in accordance with their contract, and (*b*) Ransomes and Rapier, Limited, for the requisite steel tub bodies for the vehicles.

THE correspondent whose letter we published in last week's issue regarding our omission to mention in our recent article on the new Post Office tube railway in London, the old pneumatic railway for the conveyance of parcels and mails between Euston and the General Post Office, may be interested to learn that this sixty years old tube railway has not, as he suggested, been forgotten. It was in fact referred to in a lecture on "Underground London," delivered on Monday before the Society of Engineers by Captain W. J. Liberty, the City of London public lighting superintendent. After describing its course and the perils attending a journey through it on account of its water-logged condition in places, the lecturer said that it was now proposed to put the tunnel into repair and to use it for accommodating underground trunk telephone cables.

THE HUMBERARM HYDRO-ELECTRIC DEVELOPMENT SCHEME, NEWFOUNDLAND

(For description see page 514)

FIG. 14—SITE OF MAIN DAM

FIG. 15—MAIN DAM DURING CONSTRUCTION

FIG. 16—DOWNSTREAM END OF EASTERN SECTION OF MAIN CANAL

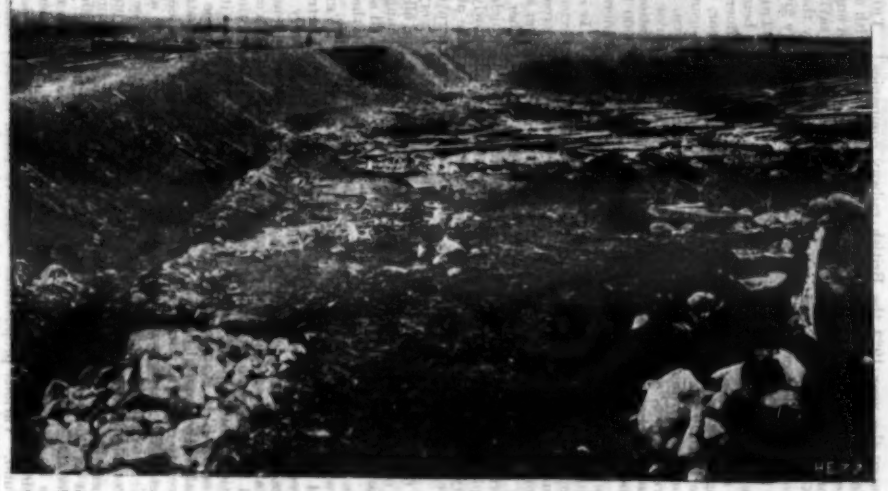


FIG. 17—THE LONG BANK, LOOKING EAST

AGENTS ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES.—Mitchell's Book Store, 576, Cangallo.
CHINA.—Kelly and Walsh, Limited, Shanghai and Hong Kong.
EGYPT.—Cairo Express Agency, near Shepheard's Hotel, Cairo.
FRANCE.—Boyveau and Chevillet, Rue de la Banque, Paris. Chapelot and Cie., 136, Bld. St. Germain, Paris.
BELGIUM.—W. H. Smith and Son, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.
INDIA.—A. I. Combridge and Co., Bombay; Thacker and Co., Limited, Bombay; Thacker, Spink and Co., Calcutta.
ITALY.—Maglioni and Strini, 307, Corso, Rome; Fratelli Treves, Corso Umberto 1, 174, Rome; Fratelli Bocca, Rome; Ulrico Hoepli, Milan.
JAPAN.—Maruzen Co., Tokyo and Yokohama.
AFRICA.—Wm. Dawson and Sons, Limited, 7, Sea-street (Box 49), Capetown.
C. Juta and Co., Johannesburg, East London, and Grahamstown.
AUSTRALIA.—Gordon and Gotch, Limited, Melbourne, Sydney, Brisbane and Perth, &c.
Melville and Mullen, Melbourne.
Atkinson and Co., Gresham-street, Adelaide.
CANADA.—Dawson, Wm., and Sons, Limited, 87, Queen-street East, Toronto.
Gordon and Gotch, Limited, 132, Bay-street, Toronto.
Montreal News Co., 386-388, St. James-street, Montreal.
Toronto News Co., 42, Yonge-street, Toronto.
CEYLON.—Wijayantna and Co., Colombo.
JAMAICA.—Educational Supply Co., Kingston.
NEW ZEALAND.—Gordon and Gotch, Limited, Wellington and Christchurch; Upton and Co., Auckland; J. Wilson Craig and Co., Napier.
STRAITS SETTLEMENTS.—Kelly and Walsh, Limited, Singapore.
UNITED STATES OF AMERICA.—International News Co., 83 and 85, Duane-street, New York; Subscription News Co., Chicago.

Agents Abroad for Advertisements.

UNITED STATES OF AMERICA.—British and Colonial Press, Inc., 161, East Erie-street, Chicago, Ill.
FRANCE.—Agence Vox, 7, Rue de Surène, Paris (VIIIe).
BELGIUM.—W. H. Smith and Son, 78/80, Rue du Marché-aux-Herbes, Bruxelles, and 44, Rue Joseph II., Ostend.

SUBSCRIPTIONS.

The Engineer can be had, by order, from any newsagent in town or country, at the various railway stations; or it can, if preferred, be supplied direct from this office.

Half-yearly (including index number) .. £1 12s. 6d.
Yearly (including two index numbers) .. £3 5s. 0d.

If credit occur, an extra charge of two shillings and sixpence per annum will be made.

Foreign Subscriptions will be received at the rates given below. Foreign subscribers paying in advance at these rates will receive The Engineer weekly and post free. Subscriptions sent by Post Office Order must be made payable to The Engineer and accompanied by letter of advice to the Publisher.

Thin Paper Copies.		Thick Paper Copies.	
Half-yearly	£1 11s. 6d.	Half-yearly	£1 13s. 9d.
Yearly	£3 3s. 0d.	Yearly	£3 7s. 6d.

(The difference to cover extra postage.)

Canadian Subscriptions—
Thin paper edition .. .. £2 18s. 6d. per annum.
Thick paper edition .. .. £3 3s. 0d. ,,

**** Reading Cases, *to hold two copies of* The Engineer, *cloth sides and leather backs, can now be supplied at 4s. 9d. each, 5s. 3d. post free.*

ADVERTISEMENTS.

**** **The charge for Situations Open and Wanted Advertisements of four lines and under is four shillings, and one shilling per line for each additional line up to one inch. When an advertisement measures an inch or more the charge is twelve shillings per inch. The rates for all other classes of advertisements, other than those mentioned above, are included in "The Engineer Directory," which is sent post free on application. All single advertisements from the country must be accompanied by a remittance in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.**

Small Advertisements cannot be inserted unless delivered before TWO o'clock on Thursday afternoon (the day before publication). ALTERATIONS to STANDING ADVERTISEMENTS must arrive not later than THURSDAY of the week preceding publication.

Letters relating to Advertisements and the Publishing Department of the Paper are to be addressed to the Publisher, all other letters to be addressed to the Editor of The Engineer.

THE ENGINEER DIRECTORY.

This Directory, which is published annually in the interests of advertisers in The Engineer, may be obtained free of charge on application to the Publisher.

Postal Address, 33, Norfolk-street, Strand, W.C. 2.
Telegr. Address, "Engineer Newspaper, Estrand, London."
Telephone Nos. 2256, 2257 Central.

PUBLISHER'S NOTICES.

*** If any Subscriber abroad should receive* The Engineer *in an imperfect or mutilated condition, he will oblige by giving prompt information of the fact to the Publisher, with the name of the Agent through whom the paper is obtained. Such inconvenience, if suffered, can be remedied by obtaining the paper direct from this office.*

TO CORRESPONDENTS.

*** All letters intended for insertion in* The Engineer *or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications*

*** We cannot undertake to return drawings or manuscripts; we must therefore request correspondents to keep copies.*

By arrangement with Reuter's Engineering Service, **The Engineer** *contains the latest news from all parts of the world which is likely to be of interest to engineers.*

Contents.

The Engineer, November 7th, 1924. PAGE

A Seven-day Journal 513
The Humberarm Hydro-electric Development in Newfoundland. (Illus.) 514
The Institution of Civil Engineers 517
Joule's Law of Electric Heating: A Historical Sketch. (Illus.) 519
Obituary—
Sir W. C. Gray 520
Sir P. C. Tempest 520
British Wire-drawing and Wire-working Machinery. No. XV. (Illus.) 520
Letters to the Editor—
M. Bertin and the Japanese Navy 521
Steam Heating a Hospital 521
Water-softening Plant at Erith. (Illus.) 522
Large Surface Grinding Machine. (Illus.) 523
Lloyd's Register of Shipping 523
Railway Matters 523
Notes and Memoranda 525
Miscellanea 525
Leading Articles—
Oncost 527
Exploring the Depths 528
One Hundred Years of British Railways. No. XIX. 528
Commercial Motor Users' Association 529
Sixty Years Ago 529
Russian Patent Law 530
Zoelly Turbine Locomotive. (Illus.) 530
A New Mechanical Stoker. (Illus.) 532
Overhead and Labour Costs 532
Smoke Abatement 533
The Dutch Cruiser Java. (Illus.) 533
Engineers in Parliament 533
Trials of T.S.S. Orama 533
Laminated Spring Forming Machine. (Illus.) 534
Modern Navigational Devices. (Illus.) 534
Contracts 537
Provincial Letters—
The Midlands and Staffordshire 537
Lancashire 537
Sheffield 538
North of England 538
Scotland 539
Wales and Adjoining Counties 539
Personal and Business Announcements 539
Current Prices for Metals and Fuels 540
French Engineering Notes 541
British Patent Specifications. (Illus.) 541
Forthcoming Engagements 542
Paragraphs—
Royal Institution 539
Faraday House Old Students' Dinner 539
Motor Lifeboat for the Isle of Wight 542

DEATH.

On Friday, October 31st, at Glasgow, Lieut.-Colonel Walter Brown, V.D., D.L., managing director of Wm. Simons and Co., Limited, of Renfrew.

THE ENGINEER.

NOVEMBER 7, 1924.

Oncost.

The selling cost of any product may be divided into three broad parts—material, labour and overhead charges. Of these parts, the first two present relatively little complexity, whilst the third is made up of a great many diverse items, rent, rates and taxes, charges on capital, power, salaries, &c. &c., and the cost of selling. Not many years ago it was the custom to take the three parts as, roughly, equal, so that the net cost of any article was composed as to one-third by the price of labour, as to one-third by the price of material, and as to the final third by oncosts or overhead charges. There were, we need not say, many marked departures from the rule, and with improved methods of costing it has almost fallen out of use. It is appreciated nowadays that costing must be carried into the closest detail and that even standing charges should be allotted in their correctly ascertained proportions to each job. But whilst it is relatively easy to estimate the costs of labour and material, it is possible only in certain cases, as, for example, in factories turning out a single standardised product, to apportion establishment charges with anything approaching accuracy. It is perchance for this reason that the burden of such charges, although it is perfectly well known, has received less general attention than that of material and labour costs. Were it as easy to analyse, let us say, the cost of selling as it is to analyse the cost of labour, then the influence of selling upon the total cost would be more generally appreciated. Again, the cost of improvements, of the introduction of new machines or new plant, or the adoption of new methods of manufacture, cannot always be allocated to their proper items. Hence the management is left in the dark as to their actual effect upon selling price, and expends money sometimes with less caution than it would do were the effects more obvious.

It is refreshing to find an American machine-tool maker attacking the subject of costs from this aspect. Mr. Ralph E. Flanders, of the Jones and Lamson Machine Company, is President of the National Machine Tool Builders' Association of America, and a few weeks ago he presented to that Association an address from which we reprint a few passages—see "Overhead and Labour Costs" on page 532. We are so accustomed to hear tales of the reckless manner in which American manufacturers jettison machines, plants, even whole factories, when something better presents itself, that a little surprise is excusable when we find an American telling manufacturers that they plunge rather too recklessly into new expenditure and hinting that what they buy is sometimes no more than a "talking point." But America is finding it just as necessary to reduce the cost of production as we, in this country, are, and Mr. Flanders invites them to look, for the moment, less at labour costs and more at overhead charges. There are, he asserts, "dollars" to be saved in the latter and only "paltry pennies" in the former. An example he gives will not escape attention. A certain motor car sells at prices between 1000 and 2000 dollars. The direct labour cost on the car is only 67 dollars! That is, we imagine, an extreme example, but Mr. Flanders's advice deserves attention in this country, although we suspect that a larger margin still remains for the reduction of British than of American labour costs. In the case of the motor car mentioned above, it is obvious that mass production has been pressed to the limit, and that the ratio of human power to mechanical power is very small indeed. Hence, it is that the labour costs are so low and that Mr. Flanders can speak of them as negligible. The man has been replaced by the machine; the percentage occupied by wages has become extremely small, and there has been an equivalent rise in the percentage occupied by material and standing charges. Clearly the position has been reached when, the human side leaving so little scope for further reduction, the producing machines must be investigated with a view to diminishing expenditure on them. In this connection, Mr. Flanders's opinions are rendered particularly valuable by his position. "Frequent and radical changes in design are expensive to maker and user alike," he says, "It takes months and may take years for the maker to get the 'bugs' out of a design, to properly tool it for manufacture, and for his men to get into their stride for production. Change is sometimes necessary, but it is always costly. For the user, the situation is as bad. After purchasing new and different machine tools, special equipment must be redesigned and rebuilt, operators must be changed and trained, the adjustment and upkeep of the new mechanism must be learned; new habits must be acquired by all concerned, and there is nothing more expensive than this. All of these factors increase the overhead—not for a few days, but for months. It will be a large saving in direct labour cost that will justify the added expense burden." That seems a strange observation to come from the lips of a machine tool maker, but Mr. Flanders knows that even the machine tool makers would gain in the long run by the cessation of the continual rivalry which shows itself in minor alterations, often, as he says in another place, no more than "talking points." Need we add that British makers will be in the heartiest accord with him in his commendation of "certain old-fashioned qualities, such as simplicity, durability and adaptability"! But workshop equipment is not the only item in oncost which Mr. Flanders attacks. He has also something to say about the cost of selling, which he remarks is "greatest of all." We should be glad to see that part of the subject developed by someone with the expert knowledge which Mr. Flanders enjoys, and with equal courage. It is certain that the public only dimly appreciates that in purchasing motor cars and other commodities it has to pay highly for costly show-rooms, expensive catalogues, high postal charges, exhibitions, and many other things. Were the proportion that selling costs bear to prices more generally known, some effort to reduce it to more reasonable proportions would follow. Consider, for example, the expenditure incurred in seeking to obtain the contract for a bridge in a distant land. Half-a-dozen firms may compete, and each of them must needs send out its own man to survey the site, and to study local conditions. The expenses incurred may run into thousands of pounds, which must be repaid on that contract, if it is secured, or on other contracts which have nothing to do with the original expenditure. What a firm loses on the swings, it endeavours to make up on the roundabouts, and thus fixes prices at a level higher than the manufacturing costs alone would justify.

It is not for us to suggest how oncosts might be reduced, or at least restrained from ascending. That is a matter for works accountants and works managers. Our purpose is rather to inquire if Mr. Flanders's estimate of the relative burden of labour costs and oncosts holds true in Great Britain. As already indicated, we suspect that because more manual labour is employed per piece here than in America, there is still a substantial margin for the reduction of the former; but whilst continuing to attack it, there is every reason why we should

consider at the same time the reduction of all manner of standing charges. It is essential that our prices should be reduced, and if one of our most important competitors is seeking means for still further lowering its prices, we must take steps in the same direction.

Exploring the Depths.

The proposal, put forward by Sir Charles Parsons some years before the war, and recently revived, that a shaft should be sunk to a depth of some twenty miles for the purpose of exploring the deeper layers of the earth's crust, has not unnaturally met with the objection "impossible." Impossible, however, is a relative term and one which has, throughout the ages, been applied to all projects of a novel or astonishing nature whose immediate realisability was not obvious to those conversant with ordinary methods. Had the engineers or shipbuilders of Columbus's day been asked to provide means for crossing the Atlantic in ships in five days they would have replied with that conclusive word—and, for the time being, they would have been right. Had the builders of the Great Eastern been asked to construct an airship capable of travelling five thousand miles at an average speed of something like eighty miles an hour, or an aeroplane able to exceed a speed of two hundred miles an hour, the task would again have been regarded as "impossible," and yet in this case we have the accomplished fact within a few generations. It is easy to multiply examples of this kind and the inference is plain: what is "impossible" to-day becomes the commonplace of to-morrow, with this important addendum, that the distance of time between "to-day" and "to-morrow" shows signs of very rapid decrease. If, then, we should admit that for the moment Sir Charles Parsons' project is of the kind liable to be regarded as impossible, what are the prospects for its realisation in some not remote future.

The combined advances of technology and science have greatly widened the dominion of man. Originally confined to the land and to the shallow waters adjoining the land, man has "conquered" the great oceans. Similarly the remote fastnesses of the land have been opened up and explored, and little remains of the unknown in desert, mountain, or polar regions—almost the only remaining objective for the ambition of the explorer in such directions is the highest pinnacle of rock which projects skywards from the Himalayas. Next, we have ourselves witnessed, in a few short years, what may well be called the conquest of the air. No longer content with crawling more or less blindly about the bottom of the ocean of air, we have not only mastered at least the rudiments of flight, but have begun to explore the upper air and to draw from it knowledge of far-reaching importance. With such a record of progress behind us—progress which has proceeded at an accelerated pace—it is not unnatural to ask in what directions further advances are to be made; like Alexander, we sigh for new worlds to conquer. But for us this is no mere matter of idle curiosity or soaring ambition; it is rather the desire still further to turn to the advantage and use of man the forces—and the resources—of Nature. And, if we face the facts, we cannot fail to realise that further progress in that direction is essential if we are to escape the fate of the spendthrift who recklessly lives upon the hoarded wealth of the past. Our resources of coal and oil are limited. The reserves of some of our important metals and minerals are still more restricted, and yet our consumption of both increases by leaps and bounds. It is true that we have not yet exhausted or even nearly exhausted the resources of the surface of the earth, and it may be that we shall only look about us—and above and beneath—when the pressure of necessity forces us to face problems of an admittedly extremely difficult nature. Yet the fields that next await attack and exploration lie in the spaces beyond the earth and in the body of the earth itself. With the conquest of the air, if not fully realised, at least fully assured, it is not unnatural to look to the space beyond and to possible communication with other bodies of the solar system. That problem presents a fascinating field for imaginative writers who have explored it with little regard to the possibilities of realisation. Some sort of actual attempts at communication with the moon and Mars—the latter, perhaps, only by signal, have been seriously discussed and possibly even tried. Yet the solution of this problem does not offer, as far as can be foreseen, any prospects of material advantage. We could hardly look to the moon or to Mars as sources of power or of metals or minerals, and if we should be brought into contact with creatures of higher intellectual attainments than ourselves, that might not be to our personal advantage. On the other hand, the alternative field—exploration of the earth beneath our feet—offers much to tempt and interest us. There is, first, the consideration that we ought to know as much as possible about the earth on which we live and depend for all our resources; as yet we have barely scratched the surface. There are potentialities of new sources of the heavier metals and minerals, and even of an enormous reservoir of power in the internal heat of the earth's crust to be considered, so that in suggesting exploration of the depths we have practical aims as well as the pursuit of knowledge before us. Moreover, the adventure would not carry us into entirely unknown conditions and the problem is capable of gradual approach. It has not so strong a sporting element as, for instance, an imaginary trip to the moon in some sort of self-propelled projectile; but, on the other hand, it is much less impossible of realisation with our existing knowledge and resources. While thus advocating for Sir Charles Parsons' proposal serious consideration on very broad grounds, we do not for a moment underrate the enormous difficulties which such a project must encounter. The physical possibility, with existing materials, of constructing a shaft many miles deep is open to discussion. We know too little of the actual conditions of temperatures and pressure prevailing at great depths, while the exact manner in which rocky materials will behave under such conditions are also largely a matter of speculation. It must be remembered, however, that in the laboratory, Bridgeman has worked with pressures of hundreds of tons per square inch, thus realising conditions which engineers would have at first sight regarded as impossible with present-day steels. As we have said above, such a problem cannot be predetermined, but it can be approached in a gradual and progressive manner. Impossibility can only be admitted when actual attempts, utilising existing resources to the fullest extent, have failed. The real difficulty lies in the cost of such an undertaking, and the fact that a financial return cannot be guaranteed or even very directly expected. Given a shaft twenty miles deep and so constructed and devised that men could exist and work at the bottom, it is not possible to say that there is any very definite prospect of a direct financial return. Indirect returns of the greatest magnitude might follow, but the undertaking itself might be as financially unremunerative as, say, a North Pole expedition. It is on these lines, however, that the problem will have to be attacked, and that sooner or later it will be attacked we are convinced. If intelligent humanity can be brought to recognise that it is or will soon become, not only eminently desirable, but even a matter of duty to explore the depths of the earth, then humanity will also be brought to put its heads and its hands—and its financial resources—together for such a purpose.

It would almost seem that so large an undertaking, of such importance to the human race in general, is a matter for international rather than national effort. It may be that the impoverished condition of the world to-day makes the moment inopportune, but there is still wealth in the world which should be and is available for exploratory projects of this kind. It would need millions, probably tens of millions, before the feasibility of the project could be proved or disproved, together with the most careful selection of a site and the co-operation of the world's best knowledge and skill in many directions. Projects of pioneering exploration have, in the past, often found generous backing; may it not be so in the present case? There are, and always will be in such cases, many who will deride the project and prove, learnedly and conclusively, that it cannot be done. They may be right, but as a rule fact has confounded the pessimist, sooner or later, where sane projects have been put forward by men, perhaps, ahead of their times. At all events, in the present instance, the potential results of success are of such importance that the effort should be well worth while, even if the cost were that of a small war.

The London and North-Eastern trains no longer use St. Pancras Station, but, when necessary, run from and to King's Cross. The grouping of the companies has effected that economy. There is no regular service from King's Cross to Cambridge and the Great Eastern line, but when that route is used Cambridge is reached in 1 hour 18 minutes as against 1 hour 15 minutes from St. Pancras. The trains from King's Cross travel *vid* Hitchin and the Hitchin and Royston line. This route is now taken by the Royal train when the King visits Sandringham.

One Hundred Years of British Railways.

No. XIX.*

PART II.—THE FIRST HALF CENTURY.

THE LANCASHIRE AND YORKSHIRE RAILWAY.

The oldest section of the Lancashire and Yorkshire is the Manchester and Bolton, which, by 1 & 2 Will. IV., c. 60, 1831, was to convert the Manchester, Bolton and Bury Canal—sanctioned in 1791—into a railway and to build the Kearsley branch—a total length of 11 miles. This proposal was subsequently modified; the railway was built parallel to the canal from Salford to Clifton Junction, and then took a direct route to Bolton, and was opened on May 29th, 1838. The canal still exists, and is the property of the Lancashire and Yorkshire Railway. There were two noticeable features about this line:—(1) The trains ran on the right-hand and not the left-hand pair of metals; and (2) the rails were laid on longitudinal wooden sleepers, then being introduced on the Great Western.

The Manchester and Leeds Railway was the actual forerunner of the Lancashire and Yorkshire. It ran from Manchester to the North Midland at Goose Hill Junction, Normanton, and was sanctioned by 6 & 7 Will. IV., c. 111, 1836. The Manchester terminus was in Lees-street, Oldham-road. The railway approached the station by a viaduct, 730 yards long, of 72 arches. The Pennine Range was pierced by the Summit Tunnel, 2860 yards long. In its construction fifteen shafts were sunk, and the work cost £251,000, or £108,000 above the estimate. The contractor gave up the job and sacrificed his bond of £3000 rather than complete it. The well-known Charlestown Curve is situated east of Todmorden. A tunnel, 250 yards long, should have been provided at that point, but, owing to the treacherous nature of the soil, the line was run round it on curves of 12-chain radius. Sowerby Bridge Tunnel is 638 yards long and Elland 410 yards. The line was opened in three sections; the western end, from Manchester to Littleborough, on July 4th, 1839; the eastern portion, from Hebden Bridge to Normanton, on October 5th, 1840; the central portion, from Littleborough to Hebden Bridge, including the Summit Tunnel, on March 1st, 1841

The Bolton and Preston Railway was sanctioned by 1 Vic., c. 121, 1837, to run from Bolton to the North Union at Euxton Junction, whence it had running powers into Preston. It was opened thus: Bolton–Adlington, February 4th, 1841; Adlington–Chorley, December 23rd, 1841; Chorley–Euxton Junction, June 22nd, 1843.

In 1840, on May 1st and July 16th, respectively, the Preston and Longridge and the Preston and Fleetwood Railways were opened and, in 1846, a branch of the latter from Poulton to Blackpool. These lines eventually became the property of the Lancashire and Yorkshire and the London and North-Western jointly.

The Manchester passenger terminus ceased to be at Oldham-road on January 1st, 1844, as on that day a line was opened from Miles Platting to Hunts Bank, and Victoria Station—so named on the day of opening—was brought into use. The Liverpool and Manchester ran into the same station as from May 4th following, and through rail communication from sea to sea—Liverpool and Hull—was thus effected. The works in Manchester cost half a million. It was said of Victoria Station that for extent and accommodation it eclipsed "the celebrated station at Derby." The gradients between Miles Platting and Victoria are 1 in 59 and 1 in 47, and the line was at first worked by stationary engines.

Four branches on the Manchester and Leeds Railway were opened as follows:—(1) From Blue Pits—Castleton—to Heywood, on April 1st, 1841, and extended to Bury on May 5th, 1848; (2) Mills Hill—Middleton Junction—to Oldham, Werneth, on March 21st, 1842; (3) North Dean to Halifax, on July 8th, 1844; and (4) Miles Platting to Ashton on April 15th, 1846. For 62 chains approaching Oldham the gradient is 1 in 27.5 rising, and is the steepest section of line in this country where passenger trains are worked regularly without assistance. When the line was opened stationary engines worked the trains on the incline, and the operations were controlled by the electric telegraph, then just introduced by Cook and Wheatstone. The line was extended to Mumps Station, Oldham, on November 1st. 1847.

A branch from North Dean to Halifax was opened on July 8th, 1844. It is 1¼ miles long, has 56 chains of 1 in 44½ rising, 20 chains of 1 in 53 and 42 chains of 1 in 76, and, from the first, has been worked by locomotives. When General Pasley, on behalf of the Board of Trade, inspected the line just before its opening, he said that the engine used on the occasion of his inspection ascended the bank with ease. The bridge over the Calder has five bays of 40ft. 6in. span on the square and 46ft. 8in. on the skew.

A line from Blackburn to the North Union at Farington was built by an independent company and opened on June 1st, 1846, and from September 1st, 1850, it had a branch from Bamber Bridge to Preston independently of the North Union. In the same year

* No. XVIII. appeared October 31st.

it became the property of the East Lancashire Company, whose line from Clifton Junction, on the Manchester and Bolton, to Rawtenstall was opened on September 28th, 1846. The length from Rawtenstall to Newchurch was opened on May 6th, 1848, and was extended to the terminus at Bacup on November 1st, 1852.

The Wakefield, Pontefract and Goole Railway—8 & 9 Vic., c. 172, 1845—covered the towns named, and under powers given the following year a branch from Knottingley to Askern and one from Pontefract to Methley were built. These branches were to be part of the Great Northern route to York and to Leeds (Midland) respectively. The Goole line was opened on April 1st, 1848; the Askern branch on June 6th, 1848, and the Methley branch on October 1st, 1849.

The Blackburn, Burnley, Accrington and Colne Railway was authorised by 8 & 9 Vic., c. 35, 1845, and under the same Act its amalgamation with the East Lancashire was authorised. It was opened thus: Blackburn–Accrington, June 19th, 1848; Accrington–Burnley, September 18th, 1848; and Burnley–Colne, February 1st, 1849. The line from the East Lancashire at Stubbins Junction to Accrington was opened on August 17th, 1848. The Blackburn Railway was an independent concern, and was opened from Bolton to Blackburn on August 12th, 1848, and from Blackburn to Chatburn on June 22nd, 1850.

Railway communication out of Liverpool, otherwise than by the Liverpool and Manchester, was first given by the Liverpool and Bury Railway, which started in Great Howard-street, Liverpool, and passed through Wigan and Bolton. When the Bury line was opened on November 20th, 1848, the Castleton–Bury line was extended a short distance to join it. The present Exchange Station in Liverpool, then known as Tithebarn-street, was opened on May 13th, 1850.

The Liverpool, Crosby and Southport Railway was opened from Southport to Waterloo on July 24th, 1848, and from Waterloo to a junction with the Liverpool and Bury at Sandhills on October 1st, 1850. The Liverpool, Ormskirk and Preston Railway was opened from Walton Junction, near Liverpool, to Lostock Hall, outside Preston, on April 2nd, 1849. A branch from Ormskirk to Rainford was brought into use on March 1st, 1858.

In Yorkshire the openings were as follows:—Mirfield–Low Moor, July, 1848; Horbury Junction–Barnsley, January 1st, 1850; Low Moor–Bradford, May 10th, 1850; Huddersfield–Penistone and Brockholes–Holmfirth, July 1st, 1850; Sowerby Bridge–Copley and Halifax–Low Moor, August 7th, 1850. The company had powers to build a line from Bowling to Leeds, but they were dropped and the line was, later, built by another company, which was acquired by the Great Northern. Communication between the East Lancashire at Burnley and the Lancashire and Yorkshire at Todmorden was given in November, 1849, and a line from Wigan to Southport was completed in April, 1855. The branch from Bradley Wood Junction to Wyke was opened in January, 1856, and the Middleton branch in 1857.

As from August, 1859, the East Lancashire Railway was amalgamated with the Lancashire and Yorkshire. One sequel to this action was the valuable running powers from Colne to Manchester and Liverpool given to the Midland Company. On July 1st, 1860, that part of Victoria Station which lies to the north of the lines to and from the London and North-Western was opened, and lines, independent of that company, ran from Salford into the enlarged portion of Victoria in August, 1865.

The Lytham branch was extended to Blackpool (Central) on April 6th, 1863, and communication between Oldham and Rochdale, together with the Royton branch, was given in November of the same year. In 1866 a short line from Aintree to Bootle was brought into use, and on September 1st the Blackrod–Horwich and the Red Moss–Hindley branches were completed. Four short lines in Yorkshire were opened thus:—Meltham branch, February 8th, 1869; Thornhill to Heckmondwike on the Mirfield–Low Moor, in May, 1869; Halifax and Ovenden, in August, 1874; and the North Dean–Stainland, January 1st, 1875. The Facit branch, from Rochdale to Facit, was brought into use on December 1st, 1870, and that part of the Padiham loop which lies between Rose Grove and Padiham on July 1st, 1875.

The North Staffordshire Railway.

On June 26th, 1846, by 9 & 10 Vic. cc. 84, 85, 86, the North Staffordshire Railway Company was authorised to make three railways:—(1) Harecastle and Crewe and Sandbach; (2) the Pottery line, Macclesfield to Colwich; and (3) the Churnet Valley, Macclesfield to Burton-on-Trent, with a branch from Tutbury to Willington on the Midland and one from Stoke to Uttoxeter. The acquisition of the Trent and Mersey Navigation was also sanctioned. The latter event had unusual features, as the principal promoters of the North Staffordshire were proprietors in the Navigation, and the transaction might almost be regarded as the Navigation Company forming the railway company. The following year the loop line through Burslem was authorised, and in 1848 the Ashbourne branch. The various lines were opened as follows:—Stoke to Norton Bridge, April 17th, 1848; Stoke to Uttoxeter, August 7th, 1848; Uttoxeter to Burton, September 11th, 1848; Stoke to Crewe and Harecastle to Congleton, October 9th, 1848; Stone to Colwich, May 1st, 1849; Congleton to Macclesfield, June 18th, 1849; North Rode to Uttoxeter, and from Marston Junction, Tutbury, to Willington, July 13th, 1849; Lawton Junction to Sandbach, January 21st, 1852; Ashbourne branch, May 31st, 1852; and Newcastle branch, September 6th, 1852.

As was related in Article No. II., the Trent and Mersey was the second authority to obtain powers—in 1776—to build a railway; the first was the Middleton tramway in 1758.

The outstanding engineering work on the North Staffordshire is seen in the three tunnels at Harecastle. Two of these, each about 1¼ mile long, are on the canal. The first was built in 1770, and is only 8ft. 6in. in width and 5ft. 10in. high above the water line. Boats are "legged" through. The second tunnel was built in 1825, and has a towing path inside, but in 1914 electrical operation was introduced, and the earlier tunnel was then closed. The third tunnel is used for the railway. It is 1 mile 3 yards long and is double tracked. There are two very fine viaducts over the river Dane near Macclesfield. That at North Rode is 1255ft. in length, has twenty arches, each of a span of 50ft., and the maximum height is 105ft. That at Congleton has ten arches of 50ft. span, and a maximum height of 111ft.

The Bucknall–Leek line was brought into use on July 1st, 1867, and the extension from Silverdale to Market Drayton on November 1st, 1869. What is still known as the Loop Line—from Hanley to Kidsgrove and one of the busiest lines in the country—was opened in four stages between November 1st, 1873, and November 15th, 1875.

The Furness and West Cumberland Railways.

There were wagon-ways in the Whitehaven district as far back as 1675, but the first public railway in the West Cumberland district was the Maryport and Carlisle, authorised on July 12th, 1837, by 1 Vic., c. 101. It was opened from Maryport to Aspatria on July 15th, 1840; from Aspatria to Wigton on May 3rd, 1843, and from Wigton to Carlisle in May, 1844. The original terminus in Carlisle was in Crown-street, but when the Lancaster and Carlisle and the Caledonian built the Citadel Station, the Maryport and Carlisle extended its line thereto and became a tenant of the new joint station on February 10th, 1845.

The Maryport and Carlisle ended at Maryport; southwards of that point, communication to Whitehaven was given by the Whitehaven Junction—7 & 8 Vic., c. 64, 1844—which was opened to Workington on January 19th, 1846; and thence to Whitehaven, Bransty, on March 19th, 1847. The Cockermouth and Workington made a branch to the former place, which was brought into use on April 28th, 1847. The Whitehaven Junction and Cockermouth and Workington were vested in the London and North-Western in 1866, and so gave that company a valuable foothold in the West Cumberland district.

The Furness was sanctioned by 7 & 8 Vic., c. 22, 1844, for a railway, mainly for the conveyance of slates, from Broughton and Kirkby to Piel Pier, with a branch from Dalton to Goldmire Junction for iron ore; also a branch from Roose to Barrow. At Foxfield Junction, Broughton, the line was joined by the Whitehaven and Furness, sanctioned by 8 & 9 Vic., c. 100, 1845. The line was opened thus:—Kirkby to Piel Pier and Dalton to Goldmire Junction, 1846; Roose to Barrow (the old station near the Cavendish Dock and the railway offices), 1847; Kirkby to Broughton, 1848; Whitehaven, Corkickle, to Ravenglass, July, 1849; Ravenglass to Bootle, July 8th, 1850; Bootle to Foxfield Junction, November, 1850. In 1851 the Furness was extended from Dalton to Kendal, and on June 7th, 1854, to Ulverston. In September, 1852, the Whitehaven and Furness was extended from the Corkickle to the Bransty Station, Whitehaven, and there joined the Whitehaven Junction Railway.

South of Ulverston lay Morecambe Bay, which had to be spanned before the Lancaster and Carlisle could be reached. This was, however, done by Brunlees, who built 10 miles of sea embankments, and viaducts over the Leven and Kent estuaries—502 and 522 yards in length respectively—and reclaimed 1000 acres of land from the sea. The line from Ulverston to Carnforth was opened on August 10th, 1857.

The Whitehaven, Cleator and Egremont Railway was built by an independent company, and was vested in the London and North-Western in 1877, and then, in 1878, in that company and the Furness jointly. It was opened to Egremont on January 11th, 1856, and extended to Sellafield on the Furness on August 1st, 1869. The Egremont company's line from Cleator to Marron Junction on the Cockermouth and Workington was opened to Rowrah on February 1st, 1864, and thence to Marron Junction in April, 1866. The Maryport and Carlisle loop between Aikbank Junction and Aspatria was brought into use on April 2nd, 1866, and a line from Bulgill to Brigham on the Cockermouth and Workington on June 1st, 1867. The Coniston branch of the Furness was opened on June 18th, 1859; the Ulverston–Lakeside in 1869; and the Arnside–Hincaster in 1876.

The Cockermouth, Keswick and Penrith was worked by the London and North-Western and North-Eastern jointly. It was opened on November 11th, 1864. The Caledonian line from Kirtlebridge over the Solway Viaduct to Kirkbridge on the Silloth branch of the North British, and from Abbeyholme on the latter line to Brayton on the Maryport and Carlisle was brought into use on September 13th, 1869. The Ravenglass and Eskdale narrow-gauge railway was put into service on May 27th, 1875.

COMMERCIAL MOTOR USERS' ASSOCIATION.

The "coming of age" of the Commercial Motor Users' Association was celebrated in an appropriate manner by a dinner, which was held at the Savoy Hotel, London, on Wednesday last.

The history of the Commercial Motor Users' Association is practically that of the commercial vehicle movement. Its authority and importance were recognised by Government Departments and local authorities. The general objects of the Association may be briefly summarised as follows:—The resisting of undue restrictions placed upon the use of commercial motor vehicles by road authorities; the origination and promotion of improvements in the laws and regulations affecting such vehicles; the support of or opposition to the alterations of such laws and regulations; the popularising and development of commercial vehicles and the collection and circulation of information which is useful to its members.

The dinner was very well attended. Mr. E. S. Shrapnell-Smith, President of the Association, was in the chair. After the loyal toasts had been honoured, Sir Arthur Stanley, on behalf of the Royal Automobile Club, presented to the Association a large silver loving cup to commemorate the occasion. The cup was fittingly acknowledged by Mr. F. G. Bristow, secretary. The toast of "The Association" was proposed by Sir W. Joynson-Hicks, who said that twenty-one years ago there were about twenty petrol lorries and 1000 steam wagons in this country, and nobody would have dared to prophesy that within twenty-one years there would be 203,156 commercial vehicles in use; of which number about 30,000 were propelled by steam, 20,000 by electricity, and the rest by petrol engines. He prophesied that the next twenty-one years would see much greater developments in this direction than the past twenty-one years. In reply to the toast, the Chairman said that the need for that Association was greater to-day than it was twenty-one years ago. The commercial transport of the country found employment for 65,000 more persons than the whole of the railways. He wished to dispel the idea that the Association was chiefly comprised of large carrying firms. That that was not the case was proved by the fact that the average number of machines per member was only five.

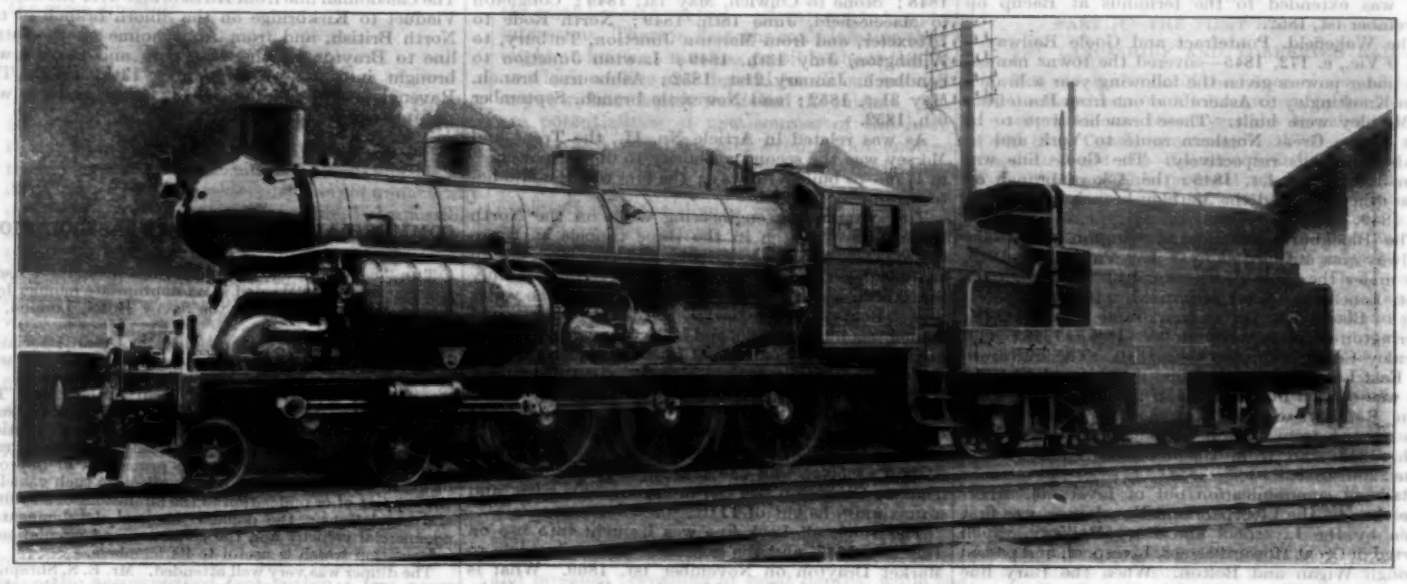
The toast of "The Ministry of Transport" was proposed by Mr. W. G. Lobjoit, Vice-president of the Association, and was replied to by Sir Henry P. Maybury. "Kindred Associations" was proposed by Colonel Crompton, who gave some amusing reminiscences of his experience in the driving of a steam omnibus fifty-three years ago. Colonel J. Sealy Clarke, President of the Society of Motor Manufacturers and Traders, responded.

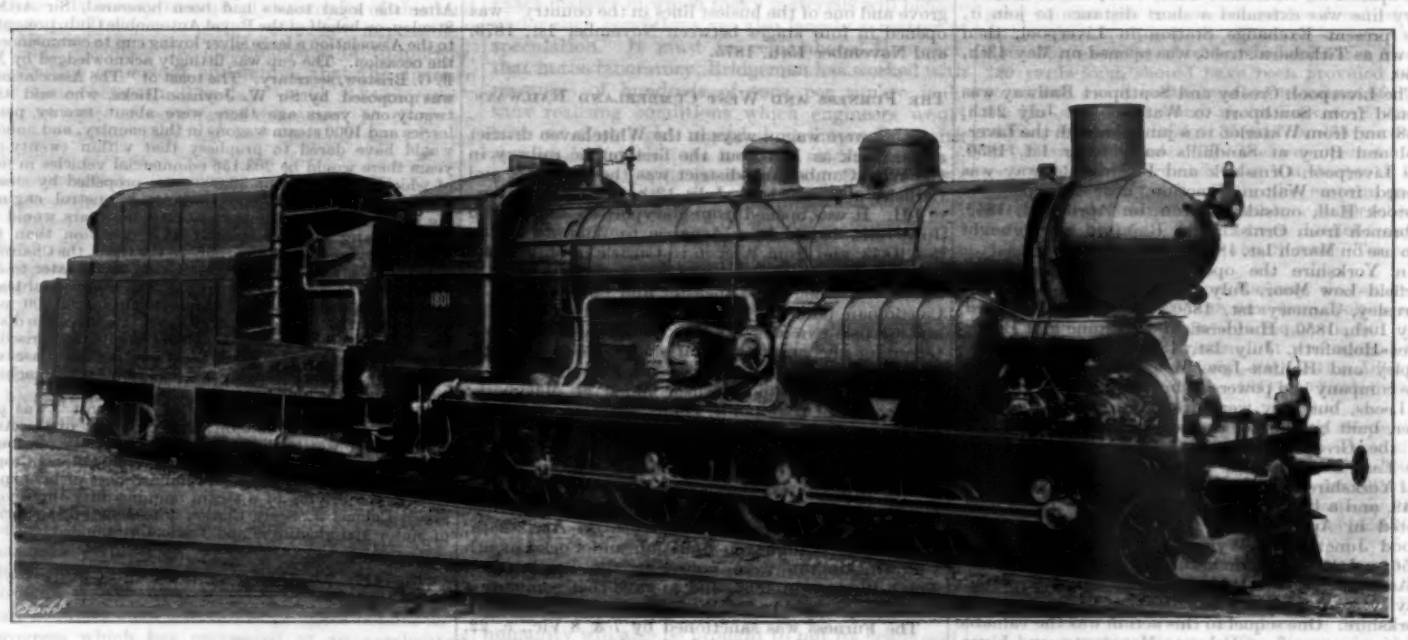
SIXTY YEARS AGO.

In our issue of November 4th, 1864, in an insignificant paragraph we recorded the beginnings of what were to be one of the greatest achievements and one of the greatest disasters in the history of engineering during the nineteenth century. We reported that at a recent meeting of the North British Railway Company the chairman, Mr. Hodgson, stated that calculations were then in progress to determine whether a great bridge across the Forth at Blackness and Charlestown would not be almost as economical as the railway ferry for the construction of which the company already possessed parliamentary powers. The river, it was added, was nearly three miles broad at the point mentioned, and the bridge, if erected, would be one of the greatest efforts of railway engineering. Another great engineering project, our paragraph continued, was for a bridge over the Forth of Tay from Newport, in Fifeshire, to Dundee. Such an undertaking would be scarcely less in magnitude than the Forth bridge, in conjunction with which it would afford an unbroken route from Edinburgh to Dundee. The Tay Bridge, begun in 1871, was completed in 1877, and after two years in service collapsed with the loss of about one hundred lives. The Forth Bridge, after a false start on designs prepared by Sir Thomas Bouch, the author of the Tay Bridge, was begun in 1881 and completed in 1888. Elsewhere we recorded an interesting archæological find during dredging operations at the mouth of the river Tyne. When at work on the bar a dredger had brought to the surface in one of its buckets a piece of ordnance, "the form of which would certainly lead one to suppose that Sir William Armstrong had been anticipated by probably a couple of centuries in the application of the principle of breechloading to heavy artillery." The weapon, "a veritable Mons Meg on a small scale," was made of wrought iron and had attached to the body a square frame of iron forming the breech. The vent piece—not found—must have been dropped within this frame and was probably held in position by means of a wooden wedge. From the trunnions to the muzzle there was a series of wrought iron rings placed side by side, which appeared as if they had been shrunk on. The piece was very much corroded and the most careful examination had failed to lead to the discovery of anything by which the date of its construction could be even approximately fixed.

SWISS FEDERAL RAILWAYS—STEAM TURBINE LOCOMOTIVE

ESCHER WYSS, LIMITED, ZURICH, AND THE SWISS LOCOMOTIVE WORKS, WINTERTHUR, ENGINEERS





Russian Patent Law.

SINCE about 1916 the patent laws of Russia have practically remained in abeyance, and as at that time many applications had been in the Patent Office for some considerable period and no patents had been granted thereon, it was very difficult for inventors in this country to ascertain what was the exact state of their applications in Russia, whether they would mature into patents or whether they would automatically become abandoned to the general public. From information recently received from several sources it appears that a serious attempt has now been made to place the patent law again on a substantial basis at least as regards new applications. Yet difficulties still arise in connection with those cases which were filed some years ago, and, indeed, those applications which matured into patents apparently must be re-registered or some other steps must be taken to cause them to have effect in Russia under the new conditions.

The latest decree is dated September 15th, 1924. According to it, patents are issued for new inventions which may be used industrially, but chemical products are excluded, although, as in this country, patents are issued for new methods of making such products. In conformity with British law and contrasted with the laws of the United States, a patent for a process covers the product obtained therefrom.

The new Russian law as regards the basis of novelty is formulated on the French law and not the British law; that is to say, an invention is not considered new if at the time of its application either in Russia or elsewhere it has been so described in a printed publication or in a specification that the principles of using it are made known to others. It is provided, according to the new law, that a patent may be obtained either by the inventor or by any person to whom his rights have been transferred.

One way in which the law differs very materially from the British law is that a patent may be obtained for what are termed "establishment inventions;" that is to say, inventions made by a group of people in an undertaking which cannot be ascribed to particular inventors. Moreover, it is possible to pass an invention made by employees to a firm, although the employees may have their names inserted in the application. This clause apparently goes further than the British law. In this country, it is true, applications are frequently made in the joint names of two or more parties as inventors, but an invention is not necessarily the property of the employer, although it may be so if the invention was made in accordance with a contract for service.

The new Russian law provides that foreign citizens have the same right for obtaining patents as citizens of the Republic, but a representative residing in Russia must be appointed. The law provides definite provisions for working and in connection with this matter includes the recent requirements of the British Patent Act or provisions somewhat similar thereto, namely, the grant of a compulsory licence under certain conditions. Working must be effected within five years from the date of the grant of the patent, and if it is not, any person interested may ask for a compulsory licence, the amount of remuneration being fixed by the Court. Apparently no provisions are made for the substitution for a compulsory licence of licences of right.

The term of a patent is fifteen years from the date of its publication, but a prolongation may be obtained up to five years if it is proved that the owner was prevented from working the invention. Patents may be compulsorily acquired by the State if they are considered of special importance either for the defence of the country or otherwise.

It would seem from information at present available that official taxes are intended to be kept low in the sense that there is to be no filing fee, nor any stamp duties for lodging oppositions. Again, renewal fees appear only to be charged from the time that the invention is commercially worked. This may result in a number of what is known as blocking patents; that is to say, patents obtained mainly for the purpose of preventing others from carrying inventions into effect while the owner of the patent does nothing.

Special provisions which are made in connection with patents previously granted are of importance to many patentees in this country who hold Russian patents. Those patents or applications which were in force on November 7th, 1917, which have not yet been acknowledged by the Soviet authorities, may form the basis of the issue of new patents on certain conditions. These appear practically to involve the filing of new specifications and drawings with a formal application and production either of the original filing certificate or certification by some document as to its loss. The term of the new patent when based on a patent granted under the old laws is fifteen years less the time intervening between the grant of the old and the new patents.

Apparently it is necessary for inventors desiring to take advantage of the issue of a new patent on the basis of an old patent to lodge their applications before September next. Those applications made under the old laws and rejected by the Patent Office authorities at that time apparently can now be submitted to appeal, although presumably if a decision on appeal were previously made no further steps can be taken. The time limited for dealing with applications in this way as far as can be seen is very short, the last date for filing apparently being December 15th, 1924.

The law provides for the protection of industrial designs probably on the basis of the German law rather than the design protection of this country, which deals with the covering of particular shapes or configurations apart from industrial use.

Zoelly Turbine Locomotive.

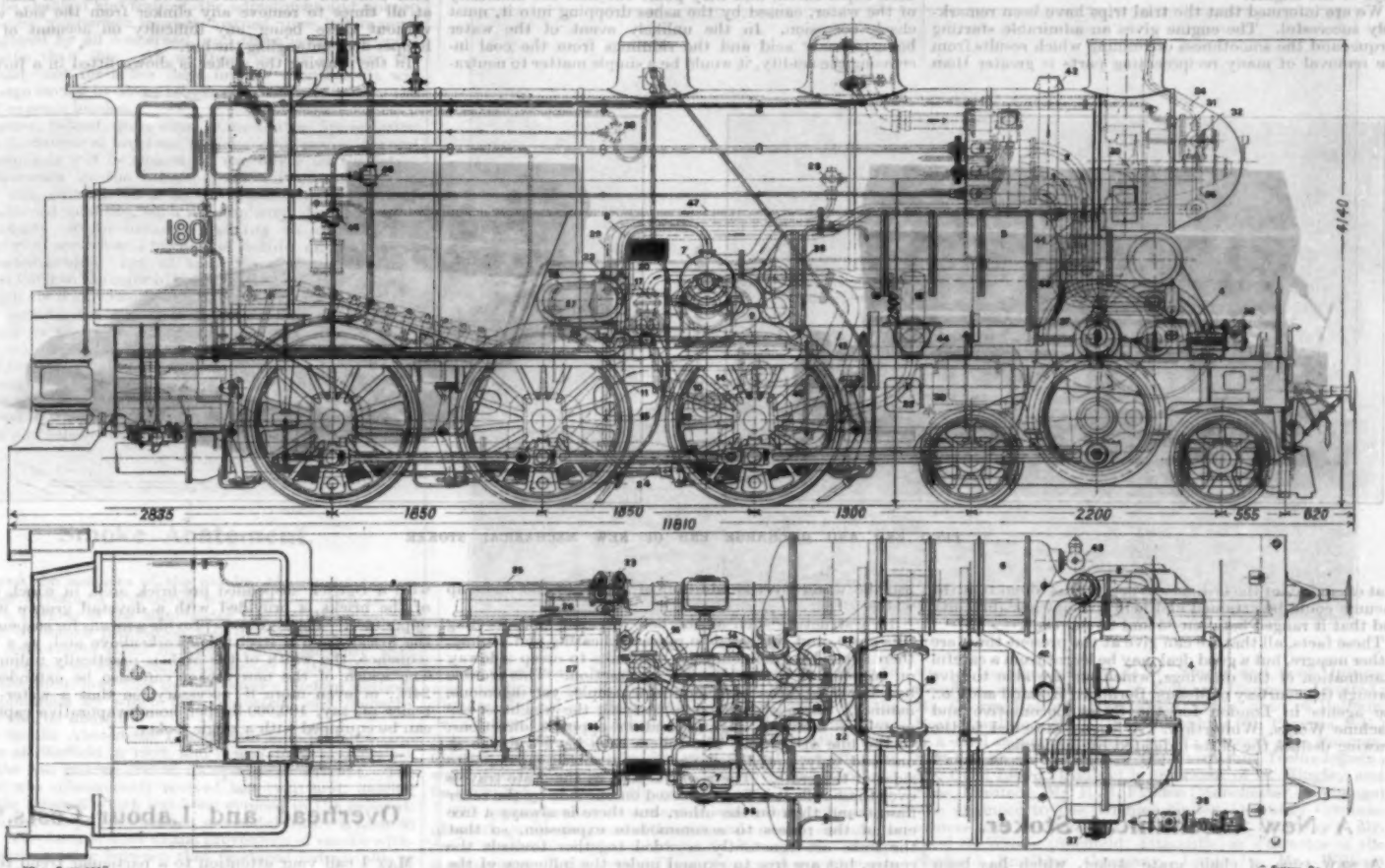
NEWS has reached this country from time to time about a locomotive fitted with a Zoelly turbine which is being built in Switzerland; but as the engine is purely experimental and as modifications have been made as the result of experiences gained, little definite information has hitherto been available. We are fortunate, however, in being in a position to-day to place before our readers some pictures of the completed locomotive and some drawings, from which a clear idea of its construction may be obtained; but even now it is impossible to give a complete description, and the results of the many trials which it has run are not yet available for publication.

The engine was built by the two Swiss works, Aktiengesellschaft der Maschinenfabriken von Escher Wyss, of Zurich, and the Schweizerische Lokomotiv und Maschinenfabrik, of Winterthur, under the patronage of the Swiss Federal Railways. Early in August last, trial trips were run between Winterthur and Romanshorn in competition with an ordinary piston locomotive using

superheated steam, so that the relative figures for fuel and water consumption might be secured. The Zoelly turbine develops about 1000 brake horse-power, which can be raised on emergency to 1500 horse-power; the maximum speed has been fixed at 47 miles per hour and the weight in working order, including tender, is 102 tons. Referring to the reproductions of photographs, it will be seen that a turbine set is carried on the bogies right under the smoke-box. Power is transmitted by double reduction gearing to a jack shaft clearly visible in the illustration, which, by means of connecting-rods, drives the leading pair of driving wheels. The ratio of transmission is 1 to 28.7, the turbine revolving at 6000 revolutions per minute for a road speed of 46½ miles per hour. A reverse turbine of the Curtis type is enclosed in the same casing; it has three stages and develops about 700 brake horse-power. The mean diameter of the turbines is about 25½ in.

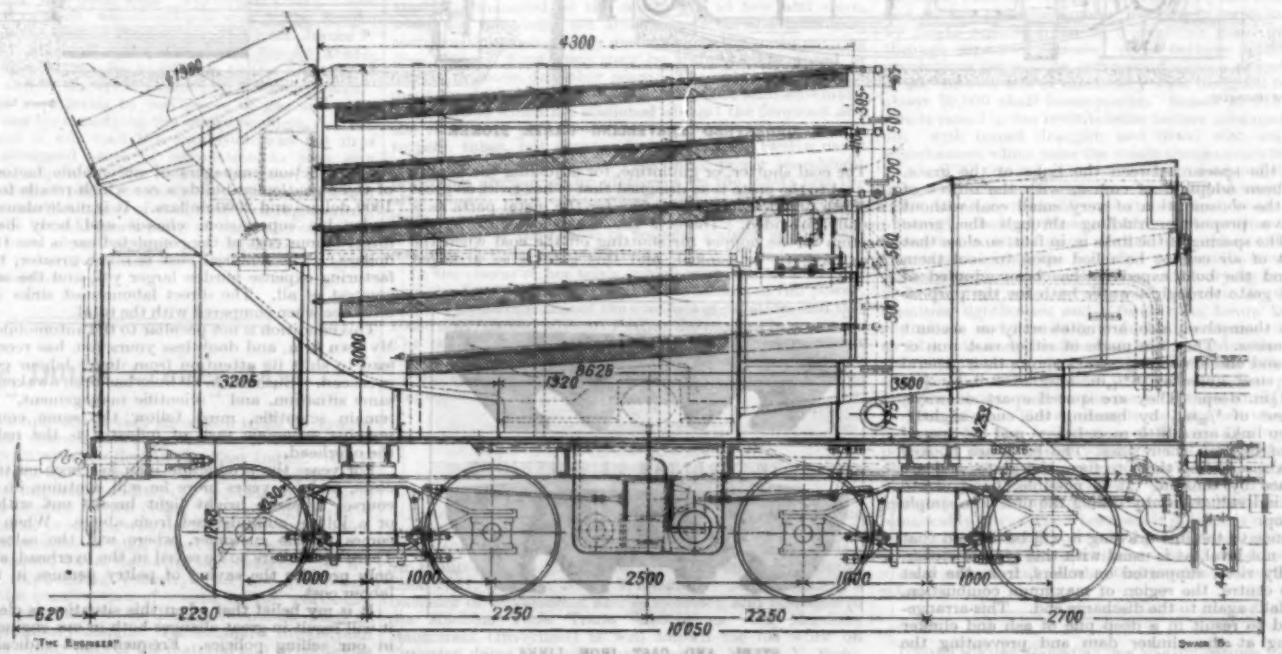
The position of the condensers is noteworthy. One is placed on each side of the boiler and is rigidly connected to the turbine casing. By this arrangement the chances of air leak are greatly reduced. The circulating water is carried in the tender and is conveyed thence to the turbines by centrifugal pumps driven by small steam turbines. After passing through the condenser it is delivered, as will be seen from one of the drawings given herewith, on to a series of channels, from which it falls over a mass of Raschig collars through which a stream of air is drawn by a large fan at the back end of the tender.

The boiler itself presents few special features. It is fitted with a Schmidt superheater and carries at the



(1) Steam pipe for ahead turbine.
(2) Auxiliary steam pipe for ahead turbine.
(3) Steam pipe for reverse turbine.
(4) Main turbine.
(5) and (6) Condensers.
(7) Air pump turbine.
(8) Steam piping for air pump turbine (waste steam from the cooling fan turbine).
(9) Gear for air pump.
(10) Circulating water pump.
(11) Suction for circulating water.
(12) Delivery pipe for circulating water.
(13) Pump for auxiliary air jet.
(14) Water admission to ditto.
(15) Water jet air exhauster for condensation.
(16) Delivery piping from ditto.
(17) Check valve.
(18) Air collector on the condensers.
(19) Piping from collector to exhauster.
(20) Air separator.
(21) Condensate pump (delivery from condenser to feed pump).
(22) Condensate piping from the condenser to the condensing water pump.
(23) Piston feed pump.
(24) Piping from condensing water pump to feed pump.
(25) Condensate overflow piping to tender.
(26) Feed water piping from feed pump to heater.
(27) Feed-water heater (waste steam from the induced draught turbine).
(28) Feed check valve.
(29) Feed water piping from heater to feed valve and boiler.
(30) Induced draught fan.
(31) Driving turbine for ditto.
(32) Rotary valve for the waste steam of the induced draught turbine.
(33) Live steam valve for ditto.
(34) Exhaust piping from ditto.
(35) Waste steam piping from di to to heater.
(36) Condensing water piping from heater to the condenser.
(37) Oil pump for the main turbine and the gear.
(38) Spare oil pump.
(39) Oil cooler.
(40) Oil reservoir for the pump set.
(41) Exhaust valve for the main turbine.
(42) Exhaust pipe.
(43) Safety valve for the pressure in the heater.
(44) Main reservoir for air brake.
(45) Live steam valve for pump turbine (spare).
(46) Live steam valve for cooler fan turbine.
(47) Waste steam piping for the brake air pump.

ZOELLY TURBINE LOCOMOTIVE

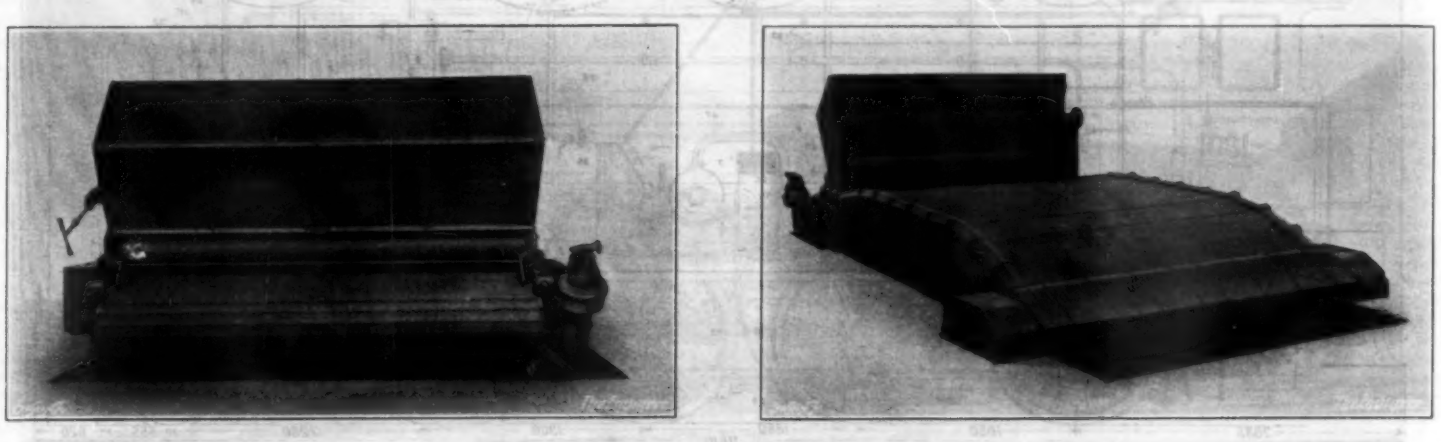


TENDER WITH WATER-COOLING PLANT FOR TURBINE LOCOMOTIVE

smoke-box end a fan driven by a steam turbine which induces the draught. This method has been found superior to the forced draught system which was tried in the early days of the engine.

We are informed that the trial trips have been remarkably successful. The engine gives an admirable starting torque, and the smoothness of running which results from the removal of many reciprocating parts is greater than that of engines of the ordinary type. It was found that the vacuum could be attained and held without any difficulty and that it ranged between 85 and 95 per cent.

These facts, all that we can give at the present time, are rather meagre, but a good deal may be learnt from a careful examination of the drawings, which we are able to give through the courtesy of Messrs. Bernhard Holland and Co., the agents in London for the Swiss Locomotive and Machine Works, Winterthur. A legend attached to the drawing defines the parts indicated by numerals.



FEED END AND DISCHARGE END OF NEW MECHANICAL STOKER

A New Mechanical Stoker.

A NEW type of chain grate stoker, which has been brought out by the Underfeed Stoker Company, Limited, of Aldwych House, London, W.C. 2, is illustrated by the half-tone engravings and line drawing on this page.

The outstanding feature of this stoker is the extreme fineness of the spaces between the links of the grate, which has been adopted, of course, with the object of permitting the consumption of very small coal without a prohibitive proportion riddling through the grate unburnt. The spacing of the links is, in fact, so close that the draught of air cannot be relied upon to cool them properly, and the bold expedient has been adopted of running the grate through a water bath for the purpose of cooling it.

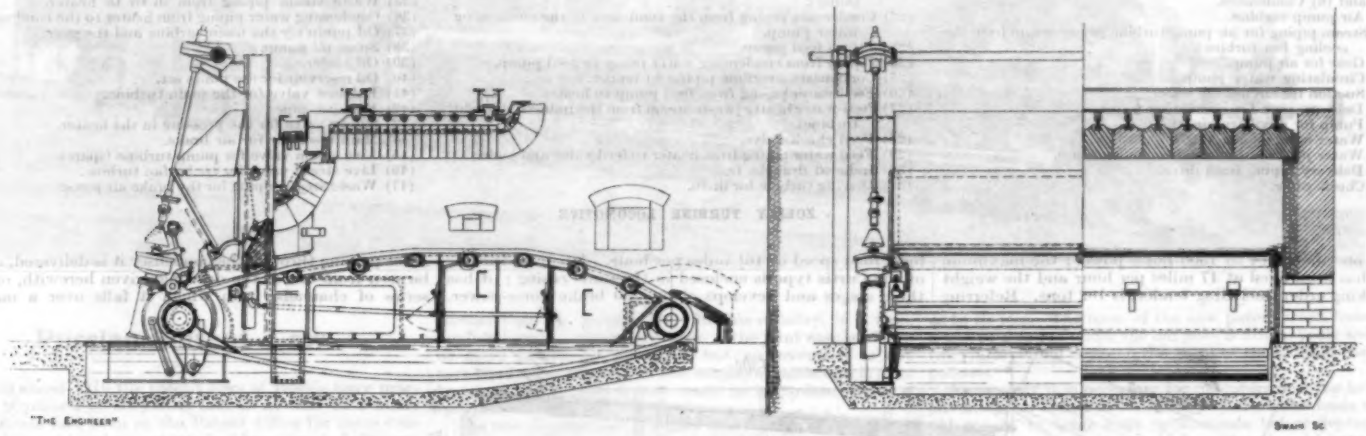
The links themselves, also, are noteworthy on account of their thinness. They are made of either cast iron or steel plate, and one of the engravings shows their general form. The steel links are $6^9/_{16}$in. long overall by $\frac{1}{4}$in. thick and $1\frac{1}{2}$in. deep. They are spaced apart sideways, to the extent of $^1/_{32}$in., by bending the ends slightly. The cast iron links are a little more heavy, and are spaced by means of lugs on their sides. The links are hooked over pins in assembling them to form the grate, and are kept in place by tension. It is possible, however, to release any individual link by taking the pull on a simple form of clamp.

On reference to the line drawing it will be noticed that the grate is not level, as is usual with this type of stoker, but gradually rises, supported on rollers, from the inlet to near the centre, the region of maximum combustion, and finally falls again to the discharge end. This arrangement is said to result in a deep pile of ash and clinker accumulating at the clinker dam and preventing the passage of excess air, while there is ample time for combustion to be completed. After passing over the back roll the grate dips down into a water trough reaching the whole length and width of the furnace, which not only very thoroughly cools the links, but also acts as an effective seal for the air supply to the grate. The air supply, by the way, is on the compartmented system adopted for previous Underfeed travelling grate stokers.

It might be thought that running the grate through a water bath would tend to corrode it away, but we are assured by the makers that no trouble of that kind has been experienced, and they point out that the alkalinity of the water, caused by the ashes dropping into it, must check corrosion. In the unlikely event of the water being already acid and the riddlings from the coal increasing the acidity, it would be a simple matter to neutralise the water by the addition of alkali to the make-up water.

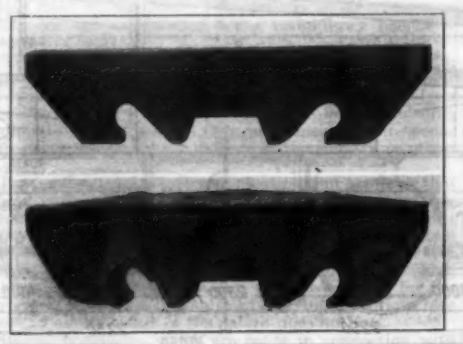
In a structure such as the belt of small links forming this grate, and subjected to repeated heating and cooling, there must be a tendency for the links to creep sideway on account of expansion and contraction. This trouble has, however, been overcome in a simple, yet ingenious, manner. Some of the rollers carrying the weight of the grate are inclined, slightly and in opposite directions, to the line of travel. The rollers each have a flange at one end only, and the flanges are arranged on opposite sides of the grate. The result is that as the grate travels over these rolls it is first squeezed on one side by the roller flange, and then on the other, but there is always a free end of the rollers to accommodate expansion, so that the links are constantly crowded together towards the centre, but are free to expand under the influence of the heat of the furnace.

The driving roll, over which the grate runs at the front, is grooved throughout its length so as to engage the links and give each one a positive drive.



NEW UNDERFEED TRAVELLING GRATE STOKER

The coal shutter, or guillotine, for adjusting the supply of coal to the grate is so designed that it has twice as great a depth of brickwork protection for the metal parts as is usually provided. There is the usual coal gate at the bottom of the hopper for shutting off the coal when the fires have to be banked, and this gate is so arranged that when it is open to permit coal flowing from the hopper on to the grate, the gate itself forms the front hopper door. This door is so arranged that it does not come right down upon the grate, as is the usual practice, but only to within 2in. or 3in. of the grate. A certain amount of coal is consequently always flooding out from the hopper upon the grate so that the coal before entering the stoker actually covers a sufficient area of the grate, and thus gives a positive feed of fuel under the shutter. This 2in.–3in. of clearance allows the use of a slice bar at all times to remove any clinker from the side walls without there being any difficulty on account of the hopper door entangling the bar.



STEEL AND CAST IRON LINKS

In the drawing the stoker is shown fitted in a furnace with a Detrick suspended fire-brick arch, in which each of the bricks is provided with a dovetail groove in its upper face. These grooves provide a means for suspending the bricks from a steel framework above and, as a consequence, the width of the arch is practically unlimited. The width of the new stoker can also be extended to 24ft., or even more if necessary, so that a water-tube boiler of, say, 100,000 lb. per hour evaporative capacity can be equipped with a single stoker.

Overhead and Labour Costs.*

MAY I call your attention to a particular trend to the business of our time, which seems to me not to be clearly seen. I refer to the decreasing importance of direct labour cost in manufacturing, and the increasing weight of the "overhead." I have been given some startling figures by the production managers of automobile factories. One of these gentlemen builds a car which retails for between 1000 dollars and 2000 dollars. It is made almost entirely under his supervision, chassis and body both. The direct labour cost of the completed car is less than 67.00 dollars! The material cost is much greater, the manufacturing expense burden larger yet, and the selling cost greatest of all. The direct labour cost sinks into insignificance when compared with the total.

This condition is not peculiar to the automobile business. My own firm, and doubtless yours too, has recently been lead to shift its attention from direct labour cost to the overhead. Business in all lines has been awakening to the same situation, and "scientific management," if it is to remain scientific, must follow the same course. The pressing economic task of industry is the reduction of the overhead.

For years the production man has been cutting labour costs, and for years more he will continue on the same course, unless a bright light breaks out within him—or a jolt is administered from above. When the light comes to the customer, where will the salesman be? There are dollars to be saved in the overhead, and he can only promise the saving of paltry pennies in the direct labour cost.

It is my belief that when this situation is clearly seen, it will result in great changes both in our engineering and in our selling policies. Frequent and radical changes in design are expensive to maker and user alike. It takes months and may take years for the maker to get the "bugs" out of a design, to properly tool it for manufacture, and for his men to get into their stride in pro-

* From an address by Ralph E. Flanders (Jones and Lamson Machine Company), at the annual meeting of National Machine Tool Builders, Lenox, Mass., October 8th, 1924.

duction. Change is sometimes necessary, but it is always costly. For the user the situation is as bad. After purchasing new and different machine tools, special equipment must be redesigned and rebuilt, operators must be changed and trained, the adjustment and upkeep of the new mechanism must be learned; new habits must be acquired by all concerned, and there is nothing more expensive than this. All of these factors increase the overhead—not for a few days but for months. It will be a large saving in direct labour cost that will justify the added expense burden.

It seems, indeed, quite clear to me that as appreciation of the fundamental problems of industry spreads, less and less emphasis will be placed by the buyer on the latest improvements in the minor details of machine tools. There will, instead, be a higher appreciation of certain old-fashioned qualities, such as simplicity, durability and adaptability of mechanism; stability of design; and character of service and fairness of dealing on the part of the manufacturer. Let us keep these things in mind, and not fall into the error of thinking that frequent changes in design are a substitute for the fundamental values.

Let nothing that has just been said be considered as standing in the way of those major improvements to which we owe the progress of the art. Neither let this line of thought cripple our efforts to root out the obsolete machinery; but let us keep these considerations in mind as being fundamental and inevitable, and be prepared to adjust to them our full range of policy in design, manufacture and salesmanship.

Smoke Abatement.

UNDER the auspices of the Smoke Abatement League of Great Britain, a conference was held this week in the Mayor's Parlour of the Manchester Town Hall, where the subject of smoke prevention was discussed from nearly every conceivable point of view. Simultaneously with the conference an exhibition was opened in the City Hall, where the public may view the best-known modern methods and appliances by which both industrial and domestic smoke can be abated.

The Smoke Abatement League was founded at a conference at Sheffield in 1909, and it was doing active work until the war put an end to its operations in 1914. The League was subsequently revived last year, and, judging from the interest which has been evinced in the proceedings during the present week, a successful future is assured for it. The League aims at the prevention of smoke without discriminating between that produced industrially or by the domestic chimney, and although it does not claim to be a technical society, it invites the co-operation of technical men, such as those who have contributed papers at Manchester.

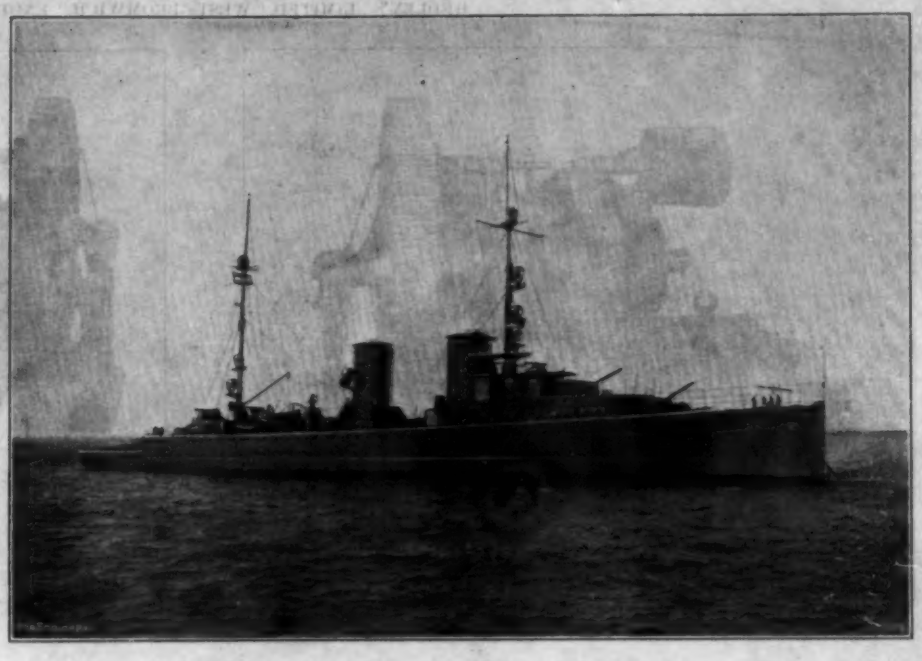
There were three sessions on each day of the conference, which opened on Tuesday, and at each sitting there was a different chairman. The papers read dealt with the many phases of the subject, opening with a paper on "Smoke Legislation in England and America," by Mr. J. W. Graham, chairman of the League. "Air Pollution" formed the subject of a paper by Dr. J. S. Owens, hon. secretary to the Advisory Committee on Atmospheric Pollution, Meteorological Office of the Air Ministry; while Sir Frank Baines, of H.M. Office of Works, discussed the "Effect of Atmospheric Impurities on Buildings." "Low Temperature Carbonisation and Smokeless Fuel, as Practised in the Smokeless Fuel Plant at Glasgow," formed the subject of a paper by Mr. Maclaurin, and some new aspects of the same subject were dealt with by Mr. Harald Nielson, F.C.S., while the qualities of "Coalite" were discussed by the Right Hon. George H. Roberts. Papers on smoke abatement were read from a mechanical engineers' point of view by Mr. T. Roland Wollaston, M.I. Mech. E., whose subject was the "Complete Gasification of Coal;" by Dr. J. T. Dunn, who dealt with "Pulverised Coal;" and by Mr. H. G. Clinch, whose subject was "The Smoke Inspector and the Cost of Production;" by Mr James T. Hodgson, M.I. Mech. E., who discussed "Smoke Abatement and Boiler Economics in relatipn to the Training of Firemen;" and by Mr. W. H. Casmey on "Boiler Design." Other papers were given by advocates of gas and electricity as means for remedying the smoke problem.

At the time of our visit the exhibition was not in a sufficiently advanced state of completion to pass any definite opinion upon it. We noticed, however, that the different makers of plant for both high temperature and low temperature distillation of coal were well represented, while, from the housekeeper's point of view, the organised exhibits of both electrical and gas apparatus for the generation of power, heat, and light should prove a great source of attraction.

The Dutch Cruiser Java.

UPON the completion of very successful trials the cruiser Java has been commissioned by the Royal Netherlands Navy for service with the fleet in the East Indies. She is the largest ship of war which has ever been built in Holland, and is the first important addition to be made to the naval forces of that country for ten years. In the programme of 1915–16 financial provision was made for the construction of three large cruisers of high speed and powerful armament, to be named Java, Sumatra, and Celebes. As the Netherlands shipbuilding industry had not previously undertaken the construction of vessels of this particular type, recourse was had to the Krupp Germania Yard at Kiel for the necessary designs. Furthermore, the German firm agreed to supply part of the material and to supervise the actual building of the ships in Holland. Under this arrangement the three cruisers were laid down—the Java at the De Schelde Yard, Flushing, in May, 1916; the Sumatra at the Netherlands Shipbuilding Company's yard, Amsterdam, in July, 1916; and the Celebes by the Fijenoord Company, Rotterdam, in the same year. It was intended that all the ships should be ready for sea within three years, but the shortage of material owing to war conditions in Europe resulted in delay, and the Sumatra did not go afloat until December 29th, 1920, the Java following her on August 6th, 1921. In the meantime it had been decided not to proceed with the third unit, Celebes, and work on that ship was stopped soon after the war. The Java is now in service, but the Sumatra will not be commissioned before the coming year.

THE DUTCH CRUISER JAVA



The type appears to represent an admirable combination of speed, gun power, seaworthiness, and cruising endurance on a moderate displacement, and although the design is nine years old the ships will bear comparison with many foreign cruisers of a much later date. The leading particulars are as follows:—Length overall, 509.5ft.; breadth, 52.5ft.; draught at full load, 18ft.; displacement at normal load, 7050 tons. In the Java there are three sets of Germania turbines coupled direct to three propeller shafts and developing an aggregate of 65,000 shaft horse-power, equivalent to a speed of 30 knots. Steam is supplied by eight small-tube Schulz-Thornycroft boilers, fired with liquid fuel. The maximum capacity of the oil tanks is 1070 tons, sufficient to steam the ship for nearly 5000 miles at a speed of 12 knots, or 3600 miles at 15 knots. The Sumatra is similar in all respects to her sister ship, save that she has geared turbines instead of direct drive. The hull is protected against gunfire by a belt of 3in. armour, which extends for a length of 392½ft. The bow section is left unplated, but the vertical armour is carried aft at a reduced thickness to protect the steering gear. An armour deck 2in. thick on the slopes and 1in. on the horizontal plane is worked over the full length of the ship. Special attention has been paid to subdivision as a defence against under-water attack. The funnel bases are armoured and there is a roomy conning tower built up of 5in. steel.

Ten 5.9in. 50-calibre guns form the main armament. They were made at the Bofors factory in Sweden. Four of them are mounted on the centre line at bow and stern, while the remaining six are disposed on the broadside, their positions being easily discernible in the accompanying illustration. Four guns may be trained right ahead or astern, or seven on either beam. The anti-aircraft armament consists of four 13-pounder 55-calibre semi-automatic guns, two of which are stationed abreast the foremast and the remaining pair abaft the mainmast. There are no torpedo tubes, but stowage is provided for twelve naval mines with dropping gear. Six large power searchlight projectors are carried on platforms on the masts and the after funnel. The complement numbers 480 officers and men. In view of the fact that the ships will probably spend most of their time in tropical waters, special care has been devoted to ventilation.

In the course of her trials, which were held some weeks ago, the Java attained a speed of 31.3 knots at full power, *i.e.*, 1.3 knots in excess of the contract stipulation, and this speed was reached without forcing the engines in any way. The cruiser is said to have proved herself an excellent sea boat. For our illustration of the ship we are indebted to the courtesy of the Chief of the Naval Staff at The Hague.

ENGINEERS IN PARLIAMENT.

AMONGST the members of the new Parliament there are several who are engineers or who are connected with engineering and kindred industries. We may mention first Sir Philip Dawson (Lewisham), who has sat in the House since 1921, and Mr. H. G. Williams (Reading), who is a Bachelor of Engineering and is secretary and manager to the Machine Tools Trade Association. Sir Murdoch Macdonald (Inverness) is well known for his work on Egyptian dams and irrigation schemes. Mr. W. E. Pease (Darlington) is connected with the Consett Iron Company and the Cleveland Bridge and Engineering Company, and Sir Philip Richardson (Chertsey) is a director of Swan, Hunter and Wigham Richardson, Limited. Amongst other members mention may be made of Captain A. M. Hudson (Hackney, N.), whose firm owns and publishes the *Ironmonger*; Sir William Bull (Hammersmith, S.), who is the chairman of J. W. Singer and Sons, bronze founders, and a director of Siemens Brothers, Limited; Mr. George Balfour (Hampstead) is the head of Balfour, Beatty and Co.; Mr. J. W. W. Hopkins (St. Pancras, S.E.) is a civil engineer; Major R. W. Barnett (St. Pancras, S.W.) is on the council of the Petroleum Technologists; Mr. Cyril Lloyd (Dudley) is chairman of N. Hingley and Sons, Limited; Mr. E. B. Fielden (Manchester, Exchange) was engineer to the Thames Valley Drainage Commissioners and chairman of the L. and Y. Railway; Mr. Cecil H. Wilson (Sheffield, Attercliffe) is a director of the Sheffield Smelting Company, Limited; Mr. William Preston (Walsall) is head of William Sanders and Co., of Wednesbury; Mr. Ernest Craig (Crewe) is a mining engineer; Captain A. H. Moreing (Camborne) is also a mining engineer; Sir Frederick Rice (Harwich) is a contractor and engineer; as is also Colonel A. McDonnell (Dartford); Mr. A. Hopkinson (Mossley) is an owner of engineering works; Lieut.-Colonel L. P. Winby (Harborough) is a civil engineer; and Captain J. K. Peto (Frome) is a managing director of the Morgan Crucible Company, Limited.

TRIALS OF THE T.S.S. ORAMA.

THE twin-screw 20,000-ton Orient liner Orama, launched at Barrow on May 20th, was delivered by Messrs. Vickers to her owners at Tilbury on October 25th, after an exhaustive series of trials extending over ten days in the Irish Sea and on the Clyde. Some particulars concerning this vessel, together with illustrations of her propelling machinery, were given in our issue of May 23rd. It may be recalled that she is driven by two sets of Parsons' turbines, each set comprising one high, one intermediate and one low-pressure turbine, working in series and driving by single reduction on to a common main gear wheel through separate pinions. At a turbine speed of 1370 revolutions per minute, corresponding to a propeller speed of 95, the two sets of machinery were designed to develop about 20,000 shaft horse-power. Steam at 215 lb. pressure is raised in ten multitubular boilers arranged to burn oil, with forced draught, and fitted with smoke tube superheaters which raise the steam temperature to 544 deg. Fah. With the exception of the main feed and circulating pumps all the auxiliaries are electrically driven. On her trials some remarkable results in fuel economy were obtained. Indeed, Messrs. Vickers believe that they have succeeded in establishing a world's record in this respect. The trials carried out included progressive tests on the Skelmorlie measured mile, at speeds varying from 14 to 20 knots, four runs at full power between the Cloch and Cumbrae lighthouses and a further six hours' full power run at sea and two 24-hour fuel consumption trials, one at 14 knots and the other at 18.8. Under the contract the fuel consumptions at various powers had to be guaranteed by the builders, and in this connection particular importance was paid to the consumptions during the two 24-hour trials. The consumptions obtained were, we are informed by the builders, as follows:—During the low power, 14 knots, trial, 0.924 lb. of fuel oil per shaft horse-power per hour; during the high power, 18.8 knots, trial, 0.785 lb. per shaft horse-power per hour. These figures include fuel consumption for all purposes, and are held to be remarkably low. Their lowness, it is held, is undoubtedly to be accounted for, in part, by the extensive adoption of electrically-driven auxiliaries and of superheat in the main turbines and in the turbine-driven electric generators.

UNDER the new Canadian law all applications for patents in Canada must be filed within one year of the first application made for the corresponding patent in another country. This provision is more strict than the requirements in the United States, where an application must be filed within one year of the first like application elsewhere, or if filed after one year, the United States application must be sealed before any like application in another country.

LAMINATED SPRING FORGING MACHINE

HEDLEY'S LIMITED, WEST BROMWICH, ENGINEERS

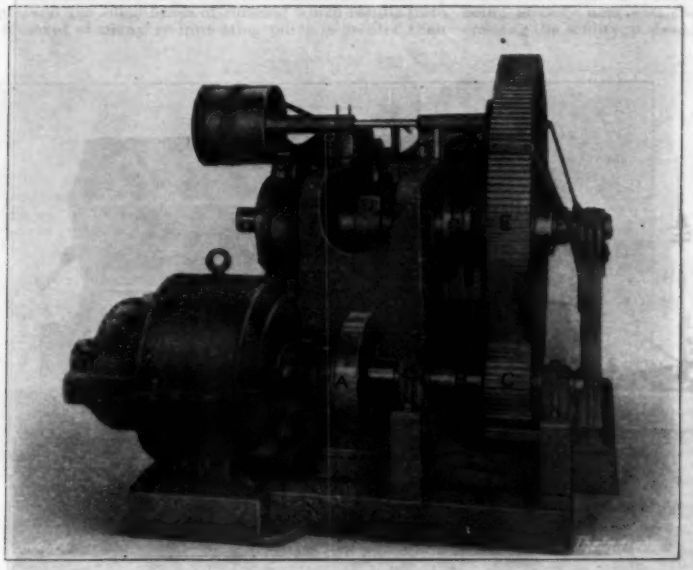


FIG. 1

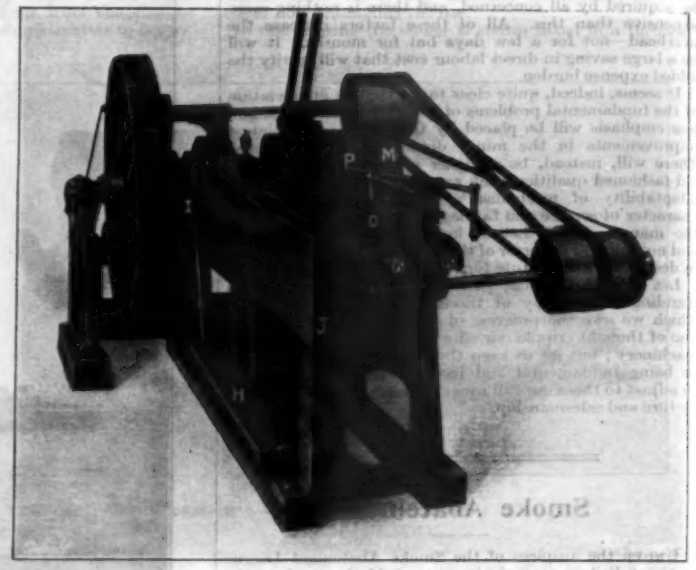


FIG. 2

Laminated Spring Forging Machine.

THE illustrations above represent a "spring forging and upsetting machine," designed for reducing labour and cost in the production of laminated springs, such as are used for motor car construction, &c. The second of its kind, made by Hedley's, Limited, of West Bromwich, to the designs of Mr. H. Maplethorpe, it has just been delivered to one of the largest steel works in Sheffield. Hitherto these springs have been generally upset by hand, from seven to nine heats being required with consequent waste by scaling.

Fig. 1 is a front view of the machine showing the electric motor and drive. The motor develops 10 horse-power at 700 revolutions with 220 volts and 43 ampères. It is coupled direct to the slipping clutch A, which is keyed to the second motion shaft B, to which is also keyed a steel machine cut pinion C, having 30 teeth 1in. pitch, 6in. face, the whole drive being carried upon a separate bed D, which is attached to a front leg on the main body of the machine. This pinion gears into the machine cut spur fly-wheel E, which has 180 teeth, and is carried by the crank shaft as shown. The crank shaft is of Siemens-Martin steel, 4¼in. diameter, having a throw of 2in., and carries the driving clutch G, which is of the slip-in pin type, the slip-in pin being 2in. diameter and made of double shear steel and hardened. The treadle H is seen in Fig. 2 on the left-hand side of the machine. When it is pressed down it causes the clutch lever to releases the slip-in pin which engages with the boss of the spur wheel. The main frame J is of cold blast iron cast in one piece of nearly 3 tons weight; the bearing for the cranks are of bronze, while the connecting rod is of cast iron and is fitted with a bronze bearing 4½ diameter for the crank pin.

The feed mechanism is seen at the rear of Fig. 2. It consists of two screw K K, 3¼in. diameter ¼in. pitch thread, driven by two worm and worm wheels having 16 teeth 1in. pitch, which in turn are driven by a straight and cross belt, as shown on the right-hand side of the machine, the whole feed mechanism taking its drive from a pulley cast on the boss of the fly-wheel. The side hammers are operated by the lever M, which operates upon a wedge. This wedge, when driven down, causes the cross slide to travel and close the die. The lever is operated by a cam on the left-hand end of the crank, seen on Fig. 1, just above the motor. A brake drum is also provided and keyed on the crank just beside the cam to prevent overrunning.

The automatic safety device to prevent overrunning of the feed mechanism is seen above and near the feed pulleys, Fig. 2. It consists of belt forks and sliding rods operated through a bell crank lever, which in turn is operated by a rod fitted with two adjustable loose collars. This rod slides through a pillar stud which is attached to the feed grip box. The feed grip box cannot be seen in the illustration, for it lies in the recess just beyond the slot seen between the two feed-screw bosses at the rear end of the machine—Fig. 2.

It is of cast steel and is fitted with two double shear steel toggle grip levers, serrated and hardened, which automatically grip the steel bar to be fed up. The first effect of the ram upon the end of the steel bar to be upset is immediately to close the toggle and so fasten the grip; hence the greater the pressure the tighter the grip.

The machine is solidly constructed, and most of the working parts are covered up to prevent scale and dirt from getting in, whilst guards are fitted over the feed screws and gear wheels to prevent accident or damage to workmen or the mechanism.

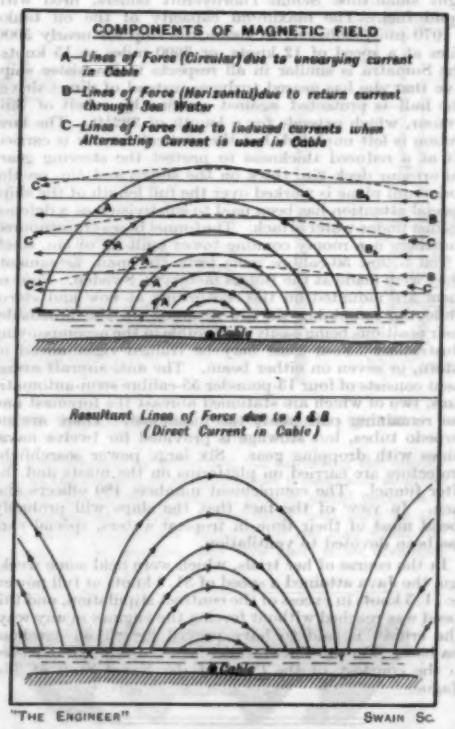
To operate the machine the spring steel is heated and the end placed between the side hammers—dies—in the slot O—Fig. 2. The operators then depresses the treadle, thus releasing the clutch pin, and upsetting begins. Then the operator with his right hand pulls the lever P, which throws the feed belt on to the fast pulley and sets the feed screws K K in motion. The feed up is at the rate of ¼in. per stroke of the ram. The speed of the machine is 80 strokes per minute and a jump up of 2in. is effected with about 20 strokes, or, say, in a quarter of a minute. Two heats are usually required for the completion of the upset of each end of a leaf spring.

The machine can deal with sections of from ¼in. by 1¼in. to ¼in. by 3in. Its total weight is about 7 tons. The tools required are of shear steel, very simple and inexpensive to make, and the change from one size to another can be effected in a few minutes.

Modern Navigational Devices.*

By F. E. SMITH, F.R.S., Director of Scientific Research, Admiralty.

WHEN I consented to give an address on "Some Modern Navigational Devices," I realised that it was impossible to describe in a single hour all recent improvements in navigational instruments, and I trust you will not


COMPONENTS OF MAGNETIC FIELD
A—Lines of Force (Circular) due to uncharging current in Cable
B—Lines of Force (Horizontal) due to return current through Sea Water
C—Lines of Force due to induced currents when Alternating Current is used in Cable
Cable
Resultant Lines of Force due to A & B (Direct Current in Cable)
Cable
"THE ENGINEER"
SWAIN Sc.

FIGS. 1 AND 2

be disappointed when I state that no description will be given of those master aids to navigation—the magnetic compass and the gyroscope. My efforts will be directed in other channels.

The compass is the chief of all navigational instruments, and its action is due to the existence of terrestrial magnetism. The gyroscope is independent of magnetic aids, but is dependent on the rotation of the earth. But if the compass and the gyroscope are in good order no external aid from mankind is needed in using them for navigational purposes. The navigational devices I propose to describe are of a different nature, inasmuch as they are based on the acoustic and electro-magnetic properties of sea water and the directiveness of radio telegraphy. In all, four devices will be described, but for three of them equipment on land is needed to co-operate with the equipment at sea.

LEADER GEAR.

One of these devices has been aptly named leader gear, and its object is to enable a vessel to find and enter a harbour or estuary in foggy weather, when the usual aids to navigation, such as buoys, light-ships, landmarks, &c., are obscured. An insulated cable, 30 or 40 miles long, is laid on the bottom of the estuary and on the sea bed along the course which it is desired the ship to traverse, and this cable is supplied with alternating current at a sonic frequency, say, 500 per second. The station generating the current is on land, or on a lightship, and the sea-end of the cable is connected to a large metallic plate, so that the return circuit is through the water. A signalling key is inserted in the cable circuit at the transmitting station, and this enables the current to be interrupted, so that messages may be transmitted if desired. The alternating-current in the cable produces an alternating magnetic field around the cable, the shape of which has been very carefully investigated. Its general form may easily be deduced from the following considerations.

First consider the current not to vary in strength. Then the lines of force due to the current in the cable are in the form of concentric circles. The return current

FIG. 3

will be in the sea water, and if the cable is a straight one the return current will be in the form of a current sheet, but the density of the current will be greatest near the cable. A uniform current sheet produces the horizontal magnetic lines of force shown in Fig. 1, and the form of the resultant field is that given in Fig. 2. It will be observed that at some distance either side from the cable the lines of force are vertical. The position X and Y are called inversion positions. If now, instead of a current of constant intensity, an alternating-current is passed through the cable, electric currents will be induced in the sea water, and again the density of the current will be greatest in the immediate vicinity of the cable. The direction of the induced current is the same as that of the current returning through the sea water, but owing to the variation in density about the cable the magnetic lines of force above the water will be curved, as shown by the dotted lines in Fig. 1. The result is that the points X Y move inwards towards the cable. With change in frequency of the alternations the distribution of the current changes and the distance between X and Y changes also, X and Y drawing nearer together as the frequency increases. The general shape of the magnetic field remains, however, that of Fig. 2. The actual shape of the field over sea water and also the shape within the water has been very carefully investigated experimentally. For this purpose a wooden barge was equipped with a tall wooden mast, to the upper

* Discourse delivered before the Royal Institution of Great Britain on the evening of Friday, February 29th, 1924.

and lower ends of which horizontal and vertical search coils were fixed for determining the horizontal and vertical components of the magnetic field. The mast was raised or lowered to place the coils at any desired height above the surface of the sea, and to place the lower coils at any depth beneath it. In addition, a long horizontal spar with electrodes at its ends was fixed to the lower end of the mast. The amplitude and phase of the electromotive force induced in the search coils and the potential difference between the electrodes were measured. Many magnetic fields were analysed.

Having thus produced an alternating magnetic field above a cable which marks out the path a ship should follow, it is necessary to place detecting apparatus on the ship. Such apparatus consists of a coil of wire on each side of the ship connected to amplifiers and to suitable telephones or other equipment. If there is a component of the magnetic field at right angles to the plane of a coil, alternating currents will be induced in the coil; if these are sufficiently intense, the telephone connected to the coil will respond. Messages may thus be read.

One such coil fitted to a torpedo-boat destroyer is shown in Fig. 3. Ships are built largely of iron—a magnetic material—and there is thus much distortion of the magnetic field in the neighbourhood of a ship, but the result is favourable. Trials at Portsmouth indicate that the coils should be inclined outwards at an angle of about 15 deg. to the vertical, and that there should be at least 2ft. of vertical hull above the top edge of the coils. Further, the centre of a coil should not be nearer than 18in. to the ship's side. Fig. 4 shows two coils in position and illustrates the screening effect of an iron ship. The coils are named port and starboard coils. The screening effect of the ship is advantageous in overcoming difficulty due to the inversion positions X Y of Fig. 2. The ship distorts the field so appreciably that except where the field is so weak that no reliability can be placed on the signals, the coil nearer the cable always receives the stronger signal.

Summing up, it will be realised that when the ship is

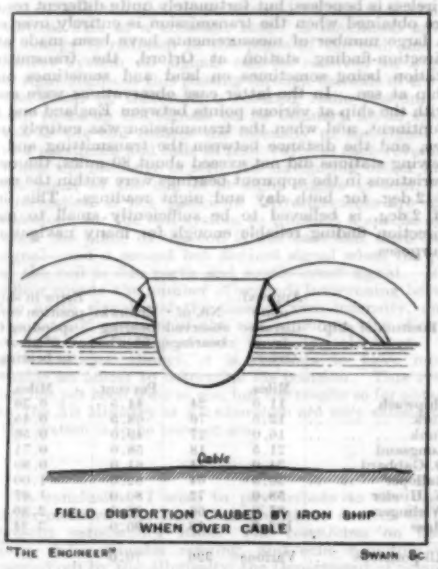


FIG. 4

directly over the cable the signals in each coil system are equal in intensity. As the ship moves away from the cable the signal in the nearer coil is the stronger, markedly at first, but the difference gradually disappears as the signals get fainter and fainter. Signals are good up to about 400 yards. To detect the cable at greater distances towed electrodes 100 yards apart have been used. The towed system consists of two insulated conductors forming a single cable, each conductor being terminated at the sea end by a suitably prepared electrode. The resultant effect is that of a towed loop of which the upper horizontal part is of copper 100 yards long. The other ends of the conductors are connected to the usual receiving apparatus, and as the effective area of the towed loop is comparatively great, the system is a sensitive receiver. With this system detection of a leader cable at more than 1200 yards is possible.

At present two leader gear systems are known to be in use, one at Portsmouth and the other in the Ambrose Channel off New York. Many ships have used these cables, and the results leave no doubt about the practicability of the system. Unfortunately the initial expense and maintenance charges are considerable. It appears that leader gear cables should be laid out to sea for some 30 to 40 miles, as it is in the approach to the channel from seaward that the mariner most needs guidance. It is possible that in the future a submarine bell or other form of acoustic transmitter will be placed at the end of a leader cable and operated by the current in the cable. In such case detection for very many miles will be possible without towed electrodes, and the cable will be much more readily located. In addition, it is possible that the receiving system will operate lamps or other visual devices. Experiments with this object have already been made.

Sub-aqueous Sound Ranging and the Radio Acoustic Method of Position Finding.

The cost of a leader cable and associated apparatus is considerable, but apart from this it is obvious that it cannot be employed for navigation in the open sea. Some means are necessary whereby a ship in a fog can readily ascertain its position, and be guided if necessary towards a leader cable. One such means is by directional wireless, which is dealt with later, and which I believe to be the soundest method because of its low cost and general applicability. A second method, proposed by Joly, which depends on the transmission of two waves with different velocities, has proved to be exceedingly accurate.

First consider the method of sub-aqueous sound ranging, which is independent of wireless but involves a knowledge of the velocity of sound in water. A sudden impulse, such as an explosion from a few ounces of gun-cotton, is produced under water by a ship. The pressure wave from this, which travels at the velocity of sound in water, spreads in all directions, and is received on three or four hydrophones or shock receivers arranged at known distances apart and connected to a central recording station. If all the shock receivers receive the impulse simultaneously they must be equidistant from the source of explosion—*i.e.*, they lie on a circle at the centre of which the explosion took place. If, however, the impulse emanates from any other point, the times of arrival of the shocks at the receivers will differ, and the differences between the times enable the position of the ship to be determined. Thus in Fig. 5, S is the ship, H_1, H_2, H_3

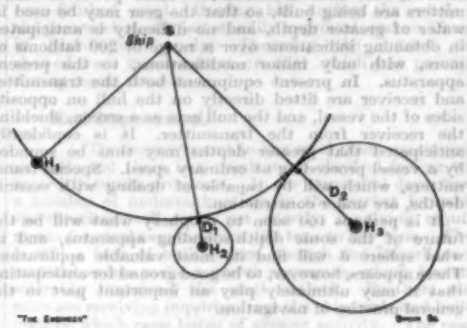


FIG. 5

the shock receivers, and D_1, D_2 the distances corresponding to the differences of times of the arrival of the shock at the receivers. The ship must then be at the centre of the circle passing through H_1 and touching the two circles. A mechanical device is used for determining position when the time differences are known. Thus the position of the ship can be found if the times of arrival of the shocks are recorded and if the velocity of sound in sea water is known. Thanks to the work of Dr. Wood and Captain Browne at the Admiralty Station at St. Margaret's Bay the velocity of sound in sea water is known as accurately as its velocity in air.

The velocity is given by

$$V = 4756 + 13.8\,t - 0.12\,t^2 + 3.73\,(S\text{-}35)\ \text{(ft./sec.)}$$

where t is the temperature and S is the salinity in parts per thousand. This formula holds over the temperature range 6 deg.–17 deg. Cent. and for salinities of about 35 per cent. In the investigation at St. Margaret's Bay a few ounces of explosive were used to produce the shock, and positions were accurately located at distances greater than 50 miles.

The shock receivers are of a special type, having single point contacts which are broken on arrival of an impulse, but are not affected by the noises of the sea. The contact is restored by an operator on shore. The contact completes an electric circuit which includes either one string of an Einthoven galvanometer, or operates a special time-measuring device known as a Phonic Chronometer. When the galvanometer is used to measure time, each shock receiver is connected to a string of the galvanometer, and on a circuit being broken a string is deflected. Photographic records are taken of the deflections, and on the same records there is a time scale enabling the intervals to be read within $^1/_{100}$th of a second. The original records are on bromide paper, the development and fixing is automatic, and the "breaks" are visible to the observer within 30 seconds of the shocks being received. In practice a sentry "receiver" is placed a considerable distance out at sea. The shock reaches this first, and the break of the "sentry" circuit starts the recording mechanism.

Another form of time recorder is the phonic chronometer, an invention due to Dr. Wood and Mr. Ford. This chronometer contains one large and three small dials with four pointers, a division on the fourth dial corresponding to an interval of $^1/_{1000}$th of a second. The maximum interval it is possible to record is 100 seconds. In practice the breaking of one circuit starts the chronometer and the breaking of a second circuit stops it; at least two chronometers are needed for one station. In practice three chronometers are assembled to form a single unit. At St. Margaret's Bay four shock receivers were used, the distance between the first and the fourth being over 70,000ft., approximately 14 miles. A long base line is necessary for accurate work.

Very accurate fixes are obtained by this method, conditionally that the ship is not at too great a distance compared with the length of the base line. When the distance is very great, good direction is obtained, but the distance is a little uncertain. This is owing to the cuts being made at acute angles, the result being a formation known as a "cat's cradle." The remedy is a longer base line or the addition of a radio signal, the latter being the more practicable. A wireless signal in air and an explosion wave in water are sent from the ship simultaneously, a simple automatic arrangement being used whereby the shock of the explosion automatically closes a circuit and transmits a wireless signal. The acoustic shock receivers operate as before. The wireless signal is received on an ordinary aerial, and after suitable amplification it produces a deflection of one of the strings of the galvanometer. As the velocity of the wireless signal is 100,000 times that of sound the interval between the reception of the wireless signal and that of a shock, multiplied by the velocity of sound, gives immediately the distance of the ship from the shock receiver.

This radio-acoustic method has been very carefully tried out at St. Margaret's Bay, and the locations obtained are believed to be more reliable than those obtained by any other method. It has proved accurate and reliable by day and night, in rough seas, in fog, and at all seasons of the year. Many locations have been given and no failures have been experienced. Of all known methods of locating position in fog this is the most accurate.

Echo Sounding.

The ordinary method of depth sounding by wire is fairly well known, and in a primitive form it was used over 2000 years ago. The fact that it has been in use so long and is still universally employed is sufficient indication of its use and reliability, and one might reasonably suppose that no improvement was needed.

But during the last few years there has been a marked tendency to replace the lead and wire by echo-sounding gear. Such gear depends upon the principle that sound travels in water at a known speed, and is reflected at the sea bed in the same way as a sound wave in air is reflected from hills or cliffs. The essentials are:—

(1) Some means to produce a sound wave under water;
(2) A knowledge of the velocity of sound in sea water;
(3) A sufficiently sensitive receiver of the echo reflected from the sea bed; and
(4) A means of measuring the interval of time between the sound impulse and the sound echo.

In sea water sound travels about 4½ times as fast as in air, the velocity being approximately 5000ft. per second, and an error of $^1/_{10}$th of a second in timing an echo results in an error of about 250ft. in the depth. Navigational officers naturally need something better than this.

The production of sound under water is exceedingly simple, submarine bells having been in use for very many years, but a continuous source is undesirable in echo work. In general a single impulse or series of impulses are required, gun-fire and mechanical shock devices being suitable. Other devices which have been constructed for producing powerful sounds under water are alternating-current oscillators, such as those produced by Fessenden, submarine syrens and steam jets. By means of these powerful acoustic generators echoes from the sea bed have been obtained at depths greater than one mile. Acoustic receivers for under water work vary considerably, and many forms of hydrophones are possible.

It is necessary now to consider how best to measure the interval of time between impulse and echo. This may be a direct measurement of the time between a single impulse and the echo; or impulses may be made to follow at such a rate that an echo due to any one impulse is received simultaneously with the transmission of the succeeding impulse; or the interval may be measured by arranging for reception to be possible only for an exceedingly short interval of time, and adjusting the time interval between impulse and the possible time of reception. Success has attended all these methods.

In 1914 Fessenden experimented in America with a submarine signalling oscillator, which was caused to emit a short note and then to receive the echo from the bottom. An observer provided with telephones and a stop watch timed the interval between the original impulse and the echo as accurately as possible, but it appears that this method of timing could not lead to accurate results. In France Monsieur Marti has employed sounds produced by gun-fire. In depths up to 500 fathoms an ordinary rifle, suitably shortened, is used, and is fired straight into the water. In greater depths a small gun of 37 mm. bore is employed. The apparatus has been used to obtain a section profile from Marseilles to Philippeville. Dr. Behm, a German engineer, employs detonation as a source of sound. The detonating system is fixed to the side of the ship above the water line, and can be loaded from the bridge. The explosion causes a mirror to rotate at a known speed, and the mirror reflects a beam of light to a scale suitably divided. The echo is received on a suitable microphone, and results in the cessation of rotation of the mirror. The depth is indicated by the position of the light spot on the scale. It appears that the system has been used for recording comparatively great depths. The United States Navy has used a sonic depth sounder to obtain a line of soundings across the Atlantic from the American coast to Gibraltar. The design of this device is based on the principle of coincidence of reception of a sound impulse with the echo of the previous impulse. Adjustment for coincidence is made by a friction wheel. When a key closes the transmitting circuit an impulse is sent out, and this is heard in one telephone receiver of a head set. After a definite interval the echo is heard, and the rate of transmitting impulses is adjusted until the train of impulses appears to coincide with the train of echoes. The United States Navy Department states that the method cannot be used to determine depths less than 40 fathoms.

For smaller depths Dr. H. C. Hayes of America has developed an angle method. The sound transmitter is located nearly amidships, and there are two lines of twelve hydrophones, one well forward and one well aft. The receivers are non-resonant, and the circuits are capable of adjustment so as to insure all impulses being received in phase. In other words, it is possible to make adjustments which compensate for the difference in time of arrival of a sound wave front on two different points of the microphone line. The calibration of these compensating devices enables the angle of approach of the wave front to be determined. Assuming that the sea floor is level, its depth is determined by triangulation once the angle of reflection has been determined. In practice a calibrated dial is used to adjust the compensator, and a direct reading in fathoms is obtained.

At present it is believed that only one line of hydrophones has been fitted on any survey vessel, but in case it is desired to take soundings with this installation over a sloping bottom, the proposition has been made to provide lines of hydrophones fore and aft in order to reduce the error which would ensue if single readings on one line were taken as correct.

In this country attention has been paid chiefly to the development of a system depending on the indirect measurement of the time interval, since the indications of an instrument working on this principle appear likely to be more reliable under all conditions than those of

any other system, and because it lends itself more easily to the production of a simple, robust and reliable installation. An apparatus working on this principle has been designed by the Research Department of the Admiralty.

In this apparatus the source of sound is a steel diaphragm, about 5in. in diameter, fixed to the hull of the ship. This diaphragm is set in vibration at regular intervals by a small spring hammer, which is withdrawn from the diaphragm by a solenoid, the circuit of the latter being broken automatically every half second. The note emitted by this transmitter has a frequency of 1250 per second, and when immersed in water the diaphragm is heavily damped, so that the energy communicated to it by the hammer is quickly transferred to the water. The receiving hydrophone is a simple microphone enclosed in a rubber body immersed in the water. This type of hydrophone is comparatively aperiodic, and has been found suitable for the work, since it is necessary, when one is dealing with such small time intervals, that both the transmitter and receiver should act quickly and not confuse the original sound and the echo of continuing to vibrate after an impulse.

Installed in the vessel, and placed in any convenient position, is a ¼ horse-power electric motor running at 1200 revolutions per minute, which drives two switches through a 10 : 1 reduction gear. Constancy of speed within 1 per cent. is obtained, in spite of large variations in the supply voltage, by the use of a specially designed centrifugal friction governor. One of the switches, which consists of a pair of brushes in contact with a rotating disc provided with an insulating segment, breaks the 100 volt direct-current supply to the transmitter every half second for a period of about 0.0025 seconds. The other switch, running on the same shaft as this disc, short circuits the telephones in the receiving circuit, except as determined by the position relative to the corresponding pair of brushes, of a second insulating segment.

When, therefore, the apparatus is running, no sound will be heard in the telephones unless the insulating

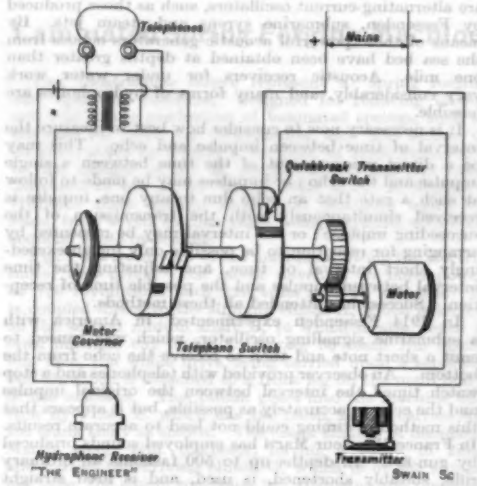


FIG. 6

segment in the telephone switch happens to open the telephone circuit at the instant when the transmitter is actuated, or at the instant when the echo returns from the bottom of the sea. By a simple mechanism the position of the brushes in the telephone circuit can be displaced by hand relative to the corresponding pair of brushes in the impulse circuit, so that an interval of time, proportional to the angular displacement of the brushes, intervenes between the emission of an impulse by the transmitter and the opening of the telephone circuit. If, then, a sound is heard in the telephone, we know that the angular displacement of the brushes gives a measure in terms of the known speed of rotation of the switch, of the time taken by the sound to travel from the transmitter to the receiver—a distance which is approximately double the depth of the water. To take a concrete example, the average velocity, over a depth of 30 fathoms, of sound in sea water of 35 per cent. salinity and at a temperature of 15 deg. Cent., is 4935ft. per second. Let us suppose that the angular displacement of the brushes relative to the insulating segment in the telephone circuit when an echo is heard is 18 deg. The time taken by the segment to rotate through 18 deg. is $^{18}/_{360} \times \frac{1}{2}$ second or $^{1}/_{40}$ second, since the segment goes round twice per second. In this time the sound will have travelled 123¾ft., and the depth of water is, therefore, a little over 10 fathoms. In practice no calculation is required, this depth being read directly on a dial. The apparatus is shown diagrammatically in Fig. 6.

As soon as the apparatus was tried at sea it was found that the system possessed a further important asset which one might describe as accidental, or at least unlooked for. One of the chief difficulties encountered in depth sounding with the vessel under way, using transmitters of moderate power, is due to the loud disturbances caused by movements of the water and sounds within the ship. If all these noises are listened to in the telephones without the short circuiting device, the echo may be difficult to distinguish because it is not loud enough to be heard distinctly through the other disturbances; but when the listening period is reduced to a small fraction of a second by the rotating switch, the echo is found to be clear and sharp.

In the specimen chart which is reproduced in Fig. 7 Somerville wire and sonic soundings obtained on a trial run are compared. The apparatus was in this case handed over to the officers of the Admiralty survey vessel, who had had little or no experience of its use. The agreement is none the less good, and this may be taken as an indication of the simplicity and reliability of the gear. In a report from the commanding officer of the vessel it is stated that the soundings were taken on a continuous run at a speed of 6 knots, under conditions which were by no means favourable—the sound of the sea being sufficient to account for the 4ft. difference between the echo sounding and that obtained with the Somerville gear. From other trials the conclusion has been drawn that reliable indications can be obtained in all depths from almost the shallowest water in which a vessel will float, up to 35 fathoms. This does not, however, represent the greatest depth which the apparatus can be expected to measure.

In the trial run to which we have referred above the installation was exactly as described, except that the instrument was graduated to read fathoms directly, instead of time, while the transmitter, instead of being fixed in the hull, was hung overboard and submerged 3ft. The receiver was placed in a 10in. sluice valve in order to shield it so far as possible from water currents and from the direct effect of the transmitter. In very shallow water a correction must be applied to allow for the distance apart of the transmitter and receiver, but this can be done very simply by an alteration in the scale of the fathom indicator. More powerful transmitters are being built, so that the gear may be used in water of greater depth, and no difficulty is anticipated in obtaining indications over a range of 200 fathoms or more, with only minor modifications, to the present apparatus. In present equipment both the transmitter and receiver are fitted directly on the hull on opposite sides of the vessel, and the hull acts as a screen, shielding the receiver from the transmitter. It is confidently anticipated that greater depths may thus be sounded by a vessel proceeding at ordinary speed. Special transmitters, which will be capable of dealing with oceanic depths, are under construction.

It is perhaps too soon to prophesy what will be the future of the sonic depth-sounding apparatus, and in what sphere it will find its most valuable application. There appears, however, to be good ground for anticipating that it may ultimately play an important part in the general practice of navigation.

Directional Wireless.

The most generally used method for determining position at sea during fog is directional wireless, the first practical directional wireless receiver being that of Bellini-Tosi. It is not possible to describe here the many investigations of directional wireless which have been made, and I propose to limit my remarks to work with which I have been connected, and more especially that of the Directional Wireless Committee of the Radio Research Board.

There has always been some suspicion about the reliability of directional wireless. Experimenters have found that the apparent and true directions of the transmitting station differ; further, the apparent direction of a fixed station varies during a single day, and at times large variations have been experienced within a few minutes. Marked disturbances have been noted at sunrise and sunset, and some of the variations are not independent of the wave length.

On the other hand, the experience of many navigating officers shows that there are conditions under which directional wireless gives reliable bearings, and it was apparent that the conditions for reliability needed to be determined. An investigation was, therefore, commenced by the Radio Research Board. In this the transmitting and receiving apparatus was investigated first, and after the errors in these had been discovered, and I may add reduced to negligible magnitude, the errors arising during transmission were measured. This investigation is not complete, but it is known that when the transmission is entirely over sea the resultant errors are small.

Consider first the transmitting and receiving apparatus. The ordinary aerial transmitting system was never under grave suspicion, and from the aspect of directional wireless it may be regarded as sufficiently perfect. Directional receiving apparatus may be considered as belonging to three types; the single rotatable coil, the Robinson double coil, and the Bellini-Tosi system of crossed aerials.

The single coil system was developed first in this country, but it has been developed also in America, and is in extensive use there. In general it is rotated about a vertical axis until signals are heard with minimum intensity, its plane then being at right angles to the direction of the incoming waves.

The Robinson system consists of two unequal coils at right angles, a switch allowing the coils to be connected so that the induced effects are added or opposed. In general the system is rotated until the signals are of maximum intensity, the plane of the larger coil then being in the direction of the incoming waves.

The Bellini-Tosi crossed aerials are fixed in position, each of the aerial systems being connected to one coil of a crossed coil transformer. The direction of the incoming waves is determined by the position of the rotatable secondary coil of the transformer when signals are of minimum strength.

The Radio Research Board experiments prove that in these instruments the causes of all instrumental errors are well understood and can be overcome, while the direction of an incoming wave can be measured with either of the three systems with appreciably the same degree of accuracy. This is a very satisfactory conclusion. Objects in the immediate vicinity of the receiving station may, however, produce appreciable errors, and a comprehensive investigation was made at ten stations in Great Britain to discover the magnitude and causes of errors in direction finding, which are local, but due to causes external to the receiving apparatus. It is not possible to make any complete statement which will cover effects of all the variables, but it was discovered that trees, telegraph wires, buildings and large masses of metal work in the immediate vicinity of the receiving apparatus produce appreciable errors, but in general, local causes of error are negligible in the case of a site chosen with care.

The changes due to geographical and meteorological conditions are not understood, but are very serious when the transmission is over land. An analysis of the results obtained at ten stations—in all there were over 40,000 observations—show that at the stations chosen bearings may be in error by considerable amounts, the range of variation of the observed bearings being in general very much greater in the evening periods than in the morning periods. Errors of 5 deg. are quite common, and occasionally errors as great as 60 deg. were observed. When the transmitting and receiving stations are comparatively near together the varintions are less, but still appreciable. This is shown in the following table:—

Transmitting station.	Observing station.	Distance in miles.	Extreme variation. Deg.
Aberdeen ..	Aberdeen	4.6 ..	1.8
Horsea	Bristol	78 ..	13.5
Chelmsford ..	Newcastle	133 ..	17.0
Cleethorpes ..	Newcastle	118 ..	12.0
Cleethorpes ..	Peterborough ..	68 ..	2.5
Chelmsford ..	Teddington	41 ..	19.3
Horsea	Teddington	52 ..	8.4
Whitehall ..	Teddington	10 ..	3.4

These results appear to show that direction finding by wireless is hopeless, but fortunately quite different results are obtained when the transmission is entirely over sea. A large number of measurements have been made at a direction-finding station at Orford, the transmitting station being sometimes on land and sometimes on a ship at sea. In the latter case observations were made with the ship at various points between England and the Continent, and when the transmission was entirely over sea, and the distance between the transmitting and receiving stations did not exceed about 80 miles, the mean variations in the apparent bearings were within the range ± 2 deg. for both day and night readings. This limit of 2 deg. is believed to be sufficiently small to make direction finding reliable enough for many navigational purposes.

Position of ship.	Approximate distance from Orford.	No. of observed bearings	Errors in bearing 0°–2°.	Error in ship's position corresponding to 2° error in bearing.
	Miles.		Per cent.	Miles.
Shipwash	11.0	24	44.5	0.36
Cork	12.5	76	68.5	0.45
Sunk	16.0	27	49.0	0.56
Longsand	21.5	18	58.0	0.71
O. Gabbard	24.0	31	61.0	0.80
Galloper	30.5	64	82.0	1.00
N. Hinder	58.0	72	80.0	1.67
Wielingen	87.0	66	85.5	2.86
Maas	102.0	18	90.0	3.34
All positions ..	Various	396	70.0	—

When determining the direction of a ship several readings are in general made, but it is not easy to determine the "radio error" unassociated with other possible

DIAGRAM SHOWING COMPARISON OF SOUNDINGS OBTAINED

With Ship's Sounding Gear ----------

" Echo " ——————

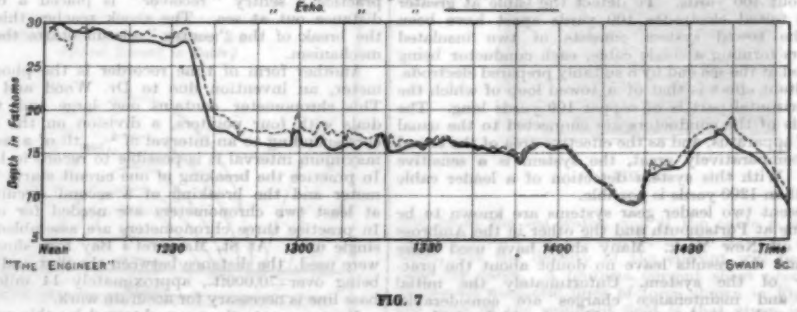


FIG. 7

errors, owing to the movement of the ship during the determination, and the difficulty of ensuring that the direction taken as "true" is absolutely correct. Nevertheless the total error is in general very small, as will be seen by inspection of the table given above. The results recorded were obtained at Orford, the observations being on ships at various positions in the North Sea. Seventy per cent. of the 396 determinations are in error by not more than ± 2 deg.

When the direction-finding station is situated some miles inland a permanent error may be introduced by the geographical conditions between the transmitter and receiver, and particularly when the direction of transmission is along a coastline. In the latter case, if the velocity of the waves is assumed to be greater over sea than over land, the deviation can be accounted for by a law analogous to that for optical refraction.

In cases where the transmission takes place over a distance not exceeding 15 miles inland, or 80 miles in all, the maximum error is that already stated, i.e., ± 2 deg., but when the distance is greater than 80 miles

the error increases, and it has been found that the variations are smaller by day than by night, and that errors of large magnitude are most likely to occur when the receiving station lies in mountainous country. It is of interest to note that when a station emits a double wave the two waves may be deviated by different amounts at any instant.

The conclusion to be drawn from the series of experiments to which I have briefly referred is that wireless direction finding is unreliable when the transmission is over land, but its reliability for sea work has been definitely proved.

In applying the results to navigation there are three possibilities. The usual method is to have two or more receiving stations on shore, the transmission being from the ship. The direction is observed at each station, one of which collects the results and estimates the position of the ship. The result is transmitted by wireless to the captain. This method is in use in this country, the Bellini-Tosi receiving system being employed.

An alternative method is to equip the ship with directional receiving apparatus, and to calibrate the equipment on the ship by observations on one transmitting station, the ship turning through 360 deg. for a complete calibration. A number of ships are so equipped and calibrated, but there are many difficulties.

In the United States the American Navy employs rotatable single coils as receiving systems on shore, and there is a separate central control office. The receiving stations cannot communicate with a ship, but on request each determines direction and transmits the result to the control office, which transmits the final result to the ship. Acknowledgment of receipt of the message completes the operation. The results appear to be exceedingly satisfactory.

It will be observed that in this system the navigating officer does not determine his position, but relies on the observations of others. This is not entirely satisfactory, and to overcome this difficulty directional transmission systems have been developed. The short-wave Marconi system of transmission is well known. In principle it is very simple. The wireless transmission is made from a suitably wound coil instead of from an ordinary aerial, and the coil is maintained in rotation about a vertical axis at a constant rate. A maximum amount of energy is radiated in the plane of the coil, and in a perfect system no signals can be received in a plane at right angles to this passing through the axis of the coil. The result is, therefore, a rotating radio beacon. The ship picks up the signals on its ordinary aerial system, and as the coil rotates the intensity of the signal rises to a maximum and falls to zero, twice in each revolution. When the intensity is zero, the navigating officer knows the plane of the coil is at right angles to him. This information is not sufficient. Arrangements are made, therefore, for the coil system to transmit a special signal when the plane of the coil is due east and west—north signal—and a second but distinct signal when the plane of the coil is due north and south—west signal. If the officer counts the number of seconds intervening between the north signal and the time of zero intensity, and if the rate of rotation of the coil is known, the direction of the transmitting station is easily calculated. Two such stations—though it is desirous to have more—enable an officer to determine his position. This system has not yet been tried at sea, but the results so far obtained by the Air Ministry at Farnborough are very satisfactory. The system is to be tried at sea.

Conclusion.

In conclusion, I wish to pay tribute to the various experimenters who have brought these devices to their present satisfactory state. The researches on Leader gear, radio acoustic ranging, and echo sounding were carried out by the Admiralty, the Department of Scientific and Industrial Research assisting financially in the first two. Most of the directional wireless work I have described has been performed under the auspices of the Radio Research Board. In all these investigations officers of the Services have played a prominent part, and no little of the success achieved is due to their interest, enthusiasm, and ready help in every way.

CONTRACTS.

Underfeed Stoker Company, Limited, of Aldwych House, Aldwych, London, W.C. 2, has recently received a repeat order from a large paper mill in Holland for six further mechanical stokers.

Smith Bros. and Co. (Hyson), Limited, of Nottingham, have received a repeat order from Vickers Naval Construction Works for valves and deck fittings similar to those supplied to the m. Orama for the sister ship m. Otranto.

Fullerton, Hodgart and Barclay, Limited, of Paisley, inform us that they have received an order from a German firm of soap manufacturers for a double effect evaporator plant for the production of glycerine from spent lyes.

Tyer and Co., Limited, of Ashwin-street, Dalston, London, E. 8, have received an order from the Buenos Aires and Pacific Railway Company for the supply of 128 key token instruments for absolute and permissive working, and for the necessary magnetos.

Goodbrand and Co., Limited, of Stalybridge, have received orders for high-pressure fuel economisers of 1536 tubes for the new Hartshead Power Station of the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board, and for a high-pressure economiser for York-street Flax Spinning Company, Limited, Belfast.

The Leeds Forge Company, Limited, of Leeds, has been successful in securing the following orders for railway rolling stock:—From the South African Railway for 50 all-steel low-sided bogie wagons, 2ft. gauge; and for 50 bogie open wagons for Natal Province. From the Crown Agents for the Colonies for the Gold Coast Railway, for 6 steel third-class bogie carriages; for the Hong Kong Railway for three steel first-class carriages, one steel first-class dining car, one steel second-class carriage, and one steel third-class carriage; and from the Great Indian Peninsula Railway for one bogie crocodile wagon, and two 4-wheeled trolley wagons.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Optimism Predominant.

The tone of the Midland iron and steel industry has improved wonderfully since the result of the General Election became known, and it is considered that before long the depression which has hung over the industry will be to some extent lifted. Pessimism appears to have vanished and optimism prevails all round. Much satisfaction is expressed at the return of a Government with such a powerful majority, and there is a concensus of opinion that with the assurance of conditions favourable to stability a widespread buying movement cannot be long delayed. There is already some evidence of activity, merchants and others keen to place orders at bottom prices having ordered quantities of pig iron and semi-finished steel. Buying has during the whole of the past week slowly but steadily improved, and on 'Change in Birmingham to-day—Thursday—the market tone showed vast improvement on that which has prevailed during recent months.

Steel Improvement.

The improvement in the steel trade continues to expand, and there is a much more cheefrul feeling with regard to future prospects. In the structural department a number of undertakings are in the market for which specifications will come out shortly, involving requirements for steel ranging from 100 tons to 200 tons. There is still a lack of bulk orders, though the miscellaneous material orders make a useful aggregate, which has considerably improved the steel outlook. Further, plate mills are receiving inquiries from the shipyards and boiler-makers, which raise hopes of greater activity. The easier prices of pig iron have enabled steel makers under the stress of keen competition to accept rather lower prices for finished material. They generally adhere to the £9 5s. figure for joists, sections, &c. In isolated cases, however, £9 has been accepted. There is a rather better inquiry for small steel bars. Producers are endeavouring to stiffen the price up to £9 10s., but bids of 2s. 6d. or even 5s. less, are not rejected if the business is at all desirable. These bars are rolled from continental billets, which can be bought at £6 2s. 6d. to £6 5s., as compared with the home price of £7 10s. Continental steel bars and semis have been offered quite recently at very cheap cutting rates, but an advance of 2s. 6d. per ton has now been notified. Billets are quoted £6 2s. 6d. delivered, and finished bars £7 2s. 6d. This is considered significant, taken in conjunction with reports which have lately been received as to the ruinous position to which prices have been reduced by fierce competition between continental firms competing for the British market. The trade in soft billets is poor, and with the present marked difference between the prices of native and foreign material it is hardly surprising that the home makers complain of lack of business.

Steel Scrap.

Steel scrap is not much wanted, buyers still ordering the suspension of deliveries. Germany is understood to have made inquiries with a view to purchases, but has not yet reached the buying stage. Heavy steel scrap can be bought at £3 15s. to £4, and turnings at £3 5s. Wrought iron scrap for the South Wales and Sheffield trades changes hands at £4 5s. delivered, 5s. or 10s. more being paid in special cases.

Finished Iron.

Though business continues slowly to improve the Staffordshire iron trade is still very short of finished iron orders, with the exception of marked bars, which are meeting with a steady demand on the £15 basis. Makers are not under any special pressure, but incoming orders are sufficient to keep the mills going. There has been a little more business moving in Crown bars since prices were reduced to £12 15s. It has not reached large proportions as yet, but even a little is very welcome at the moment. The prospects are certainly improving, for various Birmingham industries are busier and must call for larger quantities, either of wrought iron or of re-rolled steel, the latter now being turned out in increasing quantities. The tube trade and bedstead trade are taking rather more material, and small strip for the making of electric tubas is becoming a more useful line. The demand for common bar iron does not extend beyond special makes and sizes, and the reduction of price to £11 15s. still leaves a wide margin in competition with Belgium, consequently the bulk of the nut and bolt trade is kept going with Belgian bars, which have been obtainable at between £7 8s. 9d. and £7 11s. 3d. delivered in the Black Country. Those branches of manufacture in which the brittle foreign material can be used are yielding only chance orders to the home producer. For the class of trade which demands a higher grade of quality a few orders are being placed with district mills. The employment of plants is, however, very irregular.

Sheet Values Weakening.

Galvanised sheet prices have weakened further to £17 10s. for 24-gauge corrugateds, but mills well placed continue to quote £17 12s. 6d. This trade is making a large output, with good reserves of orders, but makers have large capacity and require a big volume of new business to replace orders already approaching completion, and to secure this they are prepared to shade their prices. While some manufacturers report improved business, both on home and export account, the receding quotations show that some of the mills have blank places in their rolling programmes. Black sheets are in fair demand. Fairly good quantities of sheets and thin strip are called for by the motor industries, which are having an unusually active autumn.

Raw Iron Values.

The pig iron position would appear to be on the turn. There has been increased buying this week, and some merchants have shown eagerness to place forward contracts. Some producers, however, put limits on forward contracting in the absence of any definite advance in the general level of prices. The exceptionally low prices which applied a week ago are no longer acceptable. Indeed, many producers on 'Change in Birmingham to-day asked sixpence to one shilling per ton over the generally accepted quotations. Smelters who have been extremely anxious to find trade openings at almost any practicable price are less intimidated by the stocks which have accumulated. They are content to wait developments, believing that consumptive demand is pretty sure to expand. It is considered that any improvement in demand will bring into operation additional furnaces. Several quite good contracts are stated to have been arranged this week.

Electricity Supply Scheme.

Suggestions are, I learn, under consideration for the development of the electricity supply of the Gloucester and Cheltenham area. The suggested proposals are for the combining of Cheltenham with Gloucester in the supply of the whole of North Gloucestershire, to be given from a new and powerful station to be erected on a suitable site in Gloucester. It is thought that such a proposal, embracing the supply of such an extended area, would commend itself to the Commissioners, and that by an early application it might be possible to retain that portion of the county now threatened by the Worcestershire and Shropshire Power Company on the North, and by the West Gloucester Power Company on the south. It is considered, that while a new station to supply Gloucester City only might not commend itself to the Commissioners, they might favourably consider such a station if it became a source of power for Gloucester, Cheltenham, and the whole of North Gloucestershire, as its inception would further the Commissioners' objects, and it would be admirably situated to dovetail in with even larger national plans. The provision of such a power station as indicated is estimated to cost about £200,000.

Cannock Chase Miners' Wages.

Miners in the Cannock Chase coalfield are this month to receive higher wages, the basis rate being raised by 4.65 per cent. This means that the minimum wage for stallmen is advanced by 4d. per day—from 10s. to 10s. 4d. per day. This is the first increase in wages that has taken place since June, and it is confidently expected and sincerely hoped by pit workers in this area, that there will be further increases in the next three or four months.

Unemployment Still Lessening.

The improving tendency in Midland trade continues to be demonstrated by the decline in the returns of persons unemployed in the area. Again this week there has been a reduction, the figures having fallen by 989, from 145,867 to 144,878, and as industrial activity tends to increase it is anticipated that the workless will become fewer as the weeks go by. In this area there are now 102,439 men without employment, 37,028 women, 2199 boys, and 3212 girls. Of the total the Birmingham area is responsible for 35,204—but this is 910 less than a week ago—and Coventry for 3154—212 fewer than the previous week. Decreases are also recorded at Smethwick, where the total has been reduced to 4926, Stourbridge and Brierley Hill to 4006, Tipton to 2310, Walsall to 5322, West Bromwich to 3639, and Wolverhampton to 6057. At Bilston the figures have risen by 155 to 3047, at Cradley Heath by 500 to 4580, at Dudley by 35 to 4461, and at Oldbury by 5 to 2002.

LANCASHIRE.

(From our own Correspondents.)

Manchester.

General Outlook.

Without displaying any political party bias, it can be truthfully stated that the result of the General Election came as a great relief to business men in Manchester, and it is generally considered to be the forerunner of an improvement in trade. In stating this, I do not wish to infer that the late Government has taken any deliberate step to injure the engineering industry by legislation or otherwise, but rather to emphasise the necessity for freeing the industrial community from the fears of socialistic measures which tend to throttle the springs of private enterprise. During the period of office of the late Government, there has, undoubtedly been a steady decline in the engineering industry as a whole, owing largely to a lack of confidence in our rulers, and there is little wonder that the change of Government has been hailed with a feeling of relief. What the engineering industry requires in the Government is the assurance of a continuous policy so that schemes of development, both at home and abroad, may be proceeded with. It is, of course, too early to prophesy any immediate improvement in trade, but it is rather a singular coincidence that the change of Government should synchronise with an improvement in the cotton trade, necessitating the extension of the weekly working hours. Other good news for the engineering industry is the decision of the London, Midland and Scottish Railway board to proceed immediately with the electrification of its suburban line between Manchester, Oldham and Shaw. I am also informed that one of the leading cotton mill companies near Oldham has decided upon the erection of a new mill to contain over 50,000 ring spindles, which will be electrically driven. In several other departments of the engineering industry, news has reached me of an improved tone. With so much unemployment in the country at the present time, it is both surprising and deplorable that there should be such a dearth of skilled men available, yet such is the fact. I have it on good

authority that work of considerable importance in this district is being held up from that cause, and I am assured that skilled mechanics have deserted their trade in large numbers and taken up work of other kinds, such, for instance, as tramway conductors and railway porters—sheltered occupations that are free from the uncertainties and fluctuations of trade.

Metals.

There has been rather a better feeling generally in the market for copper here, and some increase in the disposition to buy on the part of consumers and merchants; although up to the present there has not been very much speculative buying. A doubt still remains as to whether the time has at last arrived when it will be profitable to hold larger stocks of copper. It is reported that there has been more buying by consumers in America, but whether it is caused by an improvement in the consumptive trades cannot be determined yet. It may be caused by a belief that Europe, and particularly Germany, is about to buy larger quantities of American metal. A movement in favour of copper may occur now that the Presidential Election is over. A change of Goverment in America means more to business than it does here. As for the growth of demand in Europe, one cannot expect that it will be very rapid, although it ought to improve slowly. Some recovery in industrial activity is probable, not only in Europe generally, but in Great Britain, and it ought to have a favourable effect upon copper prices. In the tin market the usual sharp division of opinion is to be noticed, but it would seem as though the optimists were gaining on the pessimists. There are, at any rate, more people here who are saying that the market will eventually go up to £300, and there are not wanting people of a strong sanguine temperament who assert that in the future tin is to be dearer than it has ever been. On the other hand, it must be admitted that there are a great many "bulls" in the tin market, and that may constitute a danger later on. In the market for lead there is an increasing belief that prices are now quite high enough. In Manchester £40 per ton has been quoted for English pig lead. There is, of course, no doubt that the consumption of lead is growing; but these prices ought to stimulate the output. Spelter has been a slightly better market, but the movement would seem to be mainly a sympathetic one.

Pig Iron.

The markets here for pig iron are feeling the results of the election settlement, and although one cannot yet say that a definite and permanent improvement has taken place, there is certainly more disposition to buy, and a much stronger tone amongst sellers. While it was thought probable that the country would remain under uncertain political conditions for the life-time of another Parliament, the iron market remained very weak, and consumers persisted in looking for a further fall; but this week the question is not so much the probability of a fall, but the probability of a rise, and this change has led to quite a fair amount of buying and a large amount of inquiry. Sellers of foundry iron here are much firmer than they were, and one finds very few prepared to take orders at less than 90s. per ton delivered, while there are many who profess to believe that the normal price in Manchester will very soon be back at 92s. 6d. per ton. If the price of coke can be kept low, there would then be every opportunity for getting a good return out of the blast-furnace industry; but one feels rather doubtful about the permanence of any improvement in the price of pig iron, for the simple reason that so large a proportion of our productive capacity is still idle. The prosperity of British trade must become very much greater than it is before all our furnaces can be employed. The markets for Scotch iron and for hematite are both rather better than they were; but the latter is still relatively cheap. There seems to be an expectation here that the demand for Scotch iron in Lancashire is about to improve, and one supposes that this is based on the belief that the textile engineering industry will soon be better off for work.

Steel.

The improvement in the market feeling does not affect the manufactured section of the trade so much as the pig iron section. Nevertheless, there is rather a better feeling here in finished steel and iron, and sellers seem to be more hopeful. There were offers of joists and angles at £9 per ton, although some sellers were asking £9 2s. 6d. Plate steel was usually quoted at £10 in Manchester, but might possibly have been bought at less. The demand for iron is said to have been rather better than before; but the Lancashire works are very short of orders for bars, even if selling of hoop iron may be on a larger scale.

Scrap.

The more hopeful feeling in iron and steel seems scarcely to have reached the scrap trade yet; but, of course, this delay is only natural, for buyers must become convinced that the improvement is permanent before they give out any large orders for scrap material. Dealers here are, however, firmer, and less inclined to sacrifice their stocks at ridiculous prices. Foundry scrap is certainly steadier at 80s. to 82s. 6d. per ton, and for special qualities 85s.; while dealers are refusing to sell heavy wrought iron under 80s. Steel scrap is not much inquired for, but 60s. on trucks Lancashire is the lowest price.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron market remains dull, although there is a tendency on the part of some to entertain a more hopeful feeling as to the future. There is very little reason at the moment for this slight optimism, and it remains to be seen as to whether the hopes will be realised. At present there is but a moderate demand for ordinary mixed numbers, and customers are only taking sufficient for immediate requirements. There are no signs of the placing of orders for forward delivery. There is still a small trade with the Continent, and a small cargo left Barrow for Antwerp last week. The amount of business with America is small, but there are a few inquiries. Trade in special qualities is quiet, and inquiries are not large.

Iron Ore.

Short time is being worked at some of the iron ore mines in consequence of the quietness in the iron trade. Most of the ore raised is for local consumption, as little is going out of the district. Business in Spanish ore is limited to requirements, which are not heavy.

Steel.

The steel trade remains in a bad way, and there is no sign of the rail mills at Barrow restarting yet. The position in West Cumberland is little better. There are not many orders in the market, and the competition for them is very keen, so keen that to make a contract profitable is practically impossible.

Shipbuilding.

The Orient liner Orama has successfully passed her trials, and has been delivered to the owners by Vickers Limited. She is scheduled to start on her maiden voyage to Australia during this month. The exhaustive series of trials extended over ten days, and were carried out in the Irish Sea and on the Clyde. The principal trials which were most successful were as follows:—(1) Progressive trial on the mile at Skelmorlie at various speeds from 14 to 20 knots; (2) a full-power trial, consisting of four runs between the Cloch and Cumbrae Lights, and a further six hours at the same power at sea; (3) a twenty-four-hours' fuel consumption trial at a speed of 14 knots; (4) a twenty-four-hours' fuel consumption trial at a speed of 18.8 knots

SHEFFIELD.

(From our own Correspondent.)

A Cheerful Outlook.

THERE is a little better news with regard to the state of the steel trade this week, but perhaps the most striking feature of the situation is the feeling of optimism that is abroad. The change of Government seems to have worked wonders in the attitude of people towards the future of trade. For a considerable time it has been the general opinion that a feeling of confidence was wanted as a first essential to the restoration of prosperity, and the result of the elections has evidently engendered that feeling. The prospect of four or five years' political stability encourages the hope of a gradual expansion of trade, both at home and abroad. The prevailing feeling is reflected to a remarkable degree on the Stock Exchange. Dealings in steel shares are on a scale greatly in excess of anything known for several months, and prices have risen appreciably. Most of them are still well below par, but there have been a number of cases in which rises of three or four shillings have taken place in as many weeks, thus showing that the investors have confidence in the future.

State of the Steel Trade.

In the opinion of some experts, a new buying movement in steel has begun. The present prices of material are so low that forward ordering is regarded as sound business, and an increase in inquiries is following this view. On the crude steel side, the firms which were recently idle for several weeks owing to the strike are now working at rather higher capacity than they were before the stoppage. The plants devoted to the manufacture of railway material were beginning to run short of work, but they have received an impetus from the placing, by the home railway companies, of considerable orders for axles, tires, springs, buffers, and tools. The giving out of this work was, it is stated, advanced some weeks in order to provide employment. The Leeds Forge Company, which is associated with Cammell Laird and Co., Limited, of Sheffield, has received an order from the High Commissioner for the Union of South Africa for 50 all-steel low-sided bogie wagons. The same firm is to supply a steel bogie crocodile wagon and two other steel wagons of special type of the Gold Coast Railway and the Indian Peninsular Railway. The £500,000 contract secured by the Metropolitan-Vickers Electrical Company in connection with the electrification of the Sydney Suburban Railways is good news for Sheffield, as the company has a branch works here. The crucible steel and high-speed steel branches are still in an unsatisfactory state. Demand is limited chiefly to the home trade, continental purchases being on a small scale, and it is probably the case that not more than half the furnaces are in operation.

Cutlery and Plate.

Something like boom conditions prevail in most branches of the cutlery and plate trades, and the works are so busy that the available amount of labour is proving insufficient. This is the case in the table-knife grinding department, which is employing every grinder in the city and finding them not equal to the demand, which is chiefly for cutlery of the stainless steel variety. Spoons, forks and cased goods are also in request to an extent never before known, and there is need for more woman and girls to do the work of buffing, burnishing, and dollying. The bulk of the orders on hand are for the Christmas sales, and buyers are urgently pressing for deliveries. Owing to labour scarcity, however, the execution of the work is falling into arrears, and there is a fear that some of the orders will have to be cancelled. The activity is not so marked in the hollow ware and sterling silver branches, but they, too, are sharing in the revival to a considerable extent.

Spalding Sugar Beet Factory.

The Anglo-Scottish Sugar Beet Corporation, Limited, has recently been considering sites for a sugar beet factory in the east of England, and has had before it the claims of Peterborough, Dyke—near Bourne—and Spalding. It now announces that it has selected Spalding. Some £300,000 will be spent on the factory, and it is expected that foundations will be laid this month.

Electricity for Rural Areas.

On the suggestion of the Electricity Commissioners, a report on electrical developments in the Hull area has been drawn up by Mr. Bell, the electrical engineer of Hull Corporation. This report was laid before the Electricity Committee of that body a few days ago. In view of the geographical situation of Hull, and the fact that the East Riding is an agricultural district, it seems unlikely, the engineer states, that there will be any material demand for power for industrial purposes. He submitted drafts of two schemes, on a larger and a smaller scale. The larger covered the whole of an area with a radius of approximately 20 miles from Hull, embracing Withernsea, Hornsea, Driffield, Market Weighton, North Cave, South Cave, Brough, Beverley, Cottingham, Salt End, and Hedon, and would involve a capital outlay of £384,722. The smaller scheme related to only a portion of this area, including the more thickly populated townships and districts where industrial development is more likely to take place. The expenditure in this case would be £140,518. The Electricity Committee recommends the Corporation to consider the smaller scheme. Both proposals are to be submitted to the Electricity Commissioners, but with an intimation that, unless greater financial assistance can be obtained than originally promised, the committee cannot recommend the Council to consider the first.

NORTH OF ENGLAND.

(From our own Correspondent.)

Iron and Steel Trade Recovery.

THE result of the General Election has tended to give a bright turn to the iron and steel trades, and it is generally anticipated that business will steadily develop. Certainly manufacturers are already taking a cheerful view, and it is believed that the course is now set for a gradual return to prosperity. This week business has shown a marked expansion in several directions, and more inquiries are coming forward. Of course, prices are still depressed, but manufacturers' first concern is to get their idle plant into operation, and if the demand for pig iron continues on its present scale, it should not be long before some addition is made to the number of blast-furnaces now in operation.

Export Trade Revival.

An encouraging feature is the expansion in the overseas trade in iron and steel. For some considerable time past British manufacturers have been unable to compete with continental competitors, who have enjoyed an advantage through depreciated currencies by capturing most of the foreign trade, and even invading the home market. But the pendulum is now swinging in favour of the British manufacturers, and the result is seen in the fact that for the first time for five months the exports of iron and steel from the Cleveland district exceeded 100,000 tons. More pig iron and manufactured iron and steel was shipped than in any month since May last, and the number of inquiries now circulating encourages the hope that the improvement will continue. The total pig iron shipments from Cleveland during October were:—Coastwise, 16,543 tons; foreign, 28,334 tons; total, 44,877 tons. Of this total, 13,628 tons went to Scotland, compared with 10,020 tons in September, and an export of 8150 tons to Italy represented the biggest monthly total sent there this year. Amongst other shipments were 4835 tons of pig iron to the United States, and 1230 tons to Australia. The manufactured iron and steel shipments totalled 60,622 tons, compared with 43,133 tons in September, and that despite the Indian tariff, which reduced the shipments to India, Burmah and Ceylon to only 8254 tons, whereas before the imposition of the tariff an average of nearly 20,000 tons a month was being sent. South America received 6528 tons, South and East Africa 5624 tons, and Australia 12,696.

Big Steel Contract for Tees-side.

The Crown Agents for the Colonies have placed an important steel order—for steel rails and steel sleepers—with Bolckow, Vaughan and Co., Limited, Middlesbrough. The total weight of steel ordered amounts to 24,000 tons. The materials are required for the extensions which are being carried out for the Uganda Railways in British East Africa. This order, which has come at an opportune time, will be welcomed on Tees-side, where there has been a considerable amount of unemployment for many months, and it will help to find employment for some weeks to come.

Iron and Steel Imports.

Statistics presented at this week's meeting of the Tees Conservancy Commissioners showed the quantities of iron and steel imported to the river Tees from continental countries, India and coastwise for the twelve months ending October 31st, as compared with the corresponding periods of 1922–23 and 1913–14. Pig iron brought in to the end of October last totalled 24,683 tons, as against 14,817 tons for the previous year, and 1427 tons in the same period of 1913–14. Crude sheet bars, billets, blooms, slabs, &c., imported during the past twelve months reached 95,977 tons, as compared with 77,931 tons in 1922–23, and 33,655 tons in 1913–14. Plates, bars, angles, rails, sheets, joists, &c., brought into the port totalled 20,974 tons, as against 11,371 tons in the previous year, and 19,482 tons in 1913–14.

Cleveland Iron Market.

The Cleveland pig iron market has assumed a very active appearance this week. A considerable tonnage of iron has been sold, both for home consumption and for

export, and the volume of inquiries still circulating suggests the existence of a further substantial demand. The bulk of the business, however, has been done at 79s. to 80s. per ton, and it remains to be seen whether buyers will follow an advance to 82s. 6d. per ton, which is the forward price quoted by makers for No. 3 Cleveland pig iron. The rise has created a certain amount of apprehension. There is a real danger that higher prices will curtail the demand. On the other hand, makers see no reason why with a better market they should continue to sell below cost, and possibly the market may stand a rise of 2s. 6d. per ton. The forward price of No. 1 foundry iron is put at 87s. 6d., but possibly a prompt lot might be purchased at 86s., and No. 4 foundry and No. 4 forge are respectively offered at 80s. to 79s. per ton prompt, but higher figures rule for forward contracts.

Hematite Pig Iron.

More active conditions also prevail in the East Coast hematite pig iron trade. A good business has been done this week, with the result that stocks are being rapidly reduced, and all present danger of more furnaces going out of blast may be regarded as past. Prices are very firm, but there is no further rise, mixed numbers still being on offer at 88s. per ton, with the premium for No. 1 ranging from 6d. to 1s. per ton.

Ironmaking Materials.

The foreign ore trade is still dull, and prices remain weak. Durham furnace coke is unchanged at 25s. per ton delivered at the works, but the fuel market is inclined to firmness, and an advance would create no surprise.

Manufactured Iron and Steel.

A marked improvement is also reported in the manufactured iron and steel trade. The most gratifying feature is the disposition on the part of buyers to abandon their policy of hand-to-mouth purchases, and to contract for their requirements over a period up to six months ahead. That in itself is an indication of confidence in the stability of the market, and it enables costs of production to be lowered by ensuring a more continuous rolling programme. Prices generally are unchanged, but are now firmly held.

The Coal Trade.

A much better tone prevails in the Northern coal trade. There is a large inquiry from abroad for supplies, but at the same time business is being recorded slowly, as there is still a wide margin between fitters' ideas of value and those prevailing on the Continent. At all ports abroad, the pressure of German and other competing coals is pronounced, but as qualities are inferior to British coals, consumers can only take limited quantities, and rely on British supplies for mixture purposes. The general movement abroad is still all in favour of British coals, but ultimate decisions are solely a matter of working costs, and the high price of British tends to give a move in favour of other classes. The forward outlook, however, seems to point to increased demands for Northern coals, and operators on this side are prepared to hold on rather than commit themselves too far ahead. There is little improvement in the demand for coke, and stocks remain abundant and heavy; consequently, prices are weak.

SCOTLAND.

(From our own Correspondent.)

Clyde Shipbuilding.

The tonnage launched during the month of October was greater than in any preceding month this year. This result is mainly due to the launch of four new liners. The figures for this year to date are now within reach of the highest on record for the period, and are well over the average during the past twenty years, not including the wartime period. Notwithstanding these returns, however, the industry can hardly be said to be in a flourishing condition. Yards were enlarged during wartime and since that period have not been anything like fully engaged, being now capable of turning out a much larger yearly tonnage than in pre-war days. Consequently, many empty berths are noticeable, and are being added to as new orders do not keep pace with the output. October launches included the following:—Conorin and Cathay, twin-screw steamers, 15,000 tons each, for the P. and O. Steam Navigation Company, London; Letitia, twin screw geared turbine, 13,465 tons, for the Anchor-Donaldson Line; Rasmak, twin-screw, 10,000 tons, for the P. and O., London; five steamers of 4000 tons and over, including the Historian, cargo steamer, 5000 tons, for Messrs. T. and J. Harrison, Liverpool; and the Workworth, 4950 tons, for the Dalgleish Steam Shipping Company, Newcastle-on-Tyne. The list of new orders includes one motor ship and three others of 8000 tons deadweight, and three of over 5000 and under 6000 tons.

A Blank Week.

The industrial situation during the past week was exceptionally quiet, even the restricted activities of recent months or weeks being reduced. The General Election was, of course, largely responsible for the lack of interest in markets, which interest, however, has revived to some extent already. Before the Election members on 'Change were more concerned with the gravity of the political situation than the business of the day, while as the results became known the sole topic was the tremendous success of constitutionalism and the probable effect on markets everywhere. During this period there could be, of course, no change in the trade position, and reports bear out this statement.

Steel and Iron.

Reports from steel works reiterate the necessity for fresh orders in practically all departments. Specifications for plates and sections are especially scarce, and in this connection continental competition is a serious consideration. Black and galvanised sheet makers are busy, but new orders are not now so numerous and a somewhat easier tendency in prices is noticeable. On the other hand, the increase in the demand for spelter has led to advanced quotations. Bar iron is inactive, while re-rolled steel bars have eased considerably, a price somewhere under £9 per ton having been quoted for home delivery. Inquiries for pig iron are said to be improving, but so far no increase in business has accrued.

Coal.

It has been said that the present position of the Scotch coal trade is about the worst ever experienced. Practically all classes and qualities of fuel are suffering under acute depression. Foreign demands are so reduced that many collieries are in a serious position, as in some districts the export turnover was the main, if not the only, source of disposal. Any buying on export account at present is of a meagre description and for prompt delivery. Practically nothing in the way of forward deliveries is entertained by buyers, despite keenly cut quotations. Holders, too, are offering considerably reduced prices in order to avoid further additions to losses, which are already extensive. In all districts round coals are difficult to dispose of, while the smaller sizes of washed materials are on offer at nothing short of sacrificial prices. Treble and double nuts, more particularly in Fifeshire, are about the only exception. Aggregate shipments amounted to 243,766 tons, against 246,272 tons in the preceding week, and 331,305 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

The steam coal trade displays no new feature and the conditions, on the whole, are no better, yet at the same there is a slightly more cheerful feeling prevailing. This is in anticipation of some improvement being seen at some distant date, though it has no immediate actual basis, except that the political atmosphere has been cleared and business men can look forward to a less disturbing period than was at one time feared. One effect of the overwhelming majority of the Conservatives is the recovery in colliery share values and of industrial securities in general, which indicates more confidence in the future. Local colliery shares are experiencing something in the nature of a boomlet, brought about by the fact that nationalisation is dead, at any rate on the lines proposed by Labour. It is only natural that holders of colliery shares, which have been depressed for some time past, should now more than ever decline to sell, and they are only too pleased to see an improvement in them and some possibility of their feared losses being minimised. It is interesting to note, however, that the demand for colliery shares has sprung from outside rather than from local buyers, for the reason that so far as the collieries are concerned, actual trade does not warrant values advancing, as it is questionable whether any of them are making profits except those producing anthracite coals. The view is held that it will be some time, at any rate, before there will be such an expansion in trade as to enable collieries to command higher values such as will make them a paying proposition. Not only is the current demand for steam coals very quiet, but there is still considerable reluctance to operate for supplies over next year. No fresh inquiries of any note have come on the market since I wrote a week ago, and so far as can be ascertained local exporters and foreign dep6t owners have not made any arrangements regarding coals over 1925 or even for the first six months. There is as yet too great a margin in price between buyers' and sellers' ideas. Probably later in the month the parties will come to closer grips, but the outlook is still so uncertain that there appears to be no undue disposition to take risks such as are involved in buying on the basis of the prices which are being asked by some of the collieries. In the case of some of the undertakings producing the superior grades of steam coals, coalowners have not as yet formulated definite ideas regarding the prices at which they are prepared to sell.

Coalfield Items.

The serious position in which many of the South Wales miners are placed owing to unemployment was reviewed by the Executive Council of the South Wales Miners' Federation at its meeting at Cardiff on Monday. This was brought about as the result of a deputation waiting upon it from the Mid-Rhondda area, its appeal being for grants in aid of the men affected by the closing down of the Cambrian collieries at Clydach Vale. Thousands of men are in a similar position to those at the Cambrian collieries. The Executive Council was of the opinion that something should be done to deal with the problem as a whole and, therefore, a sub-committee was appointed to make a thorough investigation of the position and report to the Council. A report was also received from the auditors regarding a matter affecting the wages ascertainment, the point submitted to Lord Buxton, the independent chairman of the Conciliation Board, being with reference to the inclusion in the costs of production of payments made by the employers in respect of workmen's compensation. Lord Buxton's decision was that the charge in the wages ascertainment should be the actual payments for compensation, irrespective of the period when liability arose.

Prospect of Collieries Resuming.

Satisfaction is felt that very shortly there is a prospect of work being resumed at the Main Colliery. This colliery has been idle for the past four months or more, first as the result of a strike and latterly as a consequence of trade depression. On Monday the miners' agent for the Avon Valley district met the representatives of the company at Skewen and made arrangements for the fixing of the conveyor price list in the No. 4 pit, which had been the chief obstacle to a settlement on a previous occasion. The result is that there is every probability of work being restarted early next week.

Ship-repairing Competition.

Reference has been made on a previous occasion to the severe competition which South Wales ship repairers have to face from continental shipyards, and during the past week an instance has come to light, showing the necessity for more elastic conditions if this district is to regain the position it formerly held. It is true that the job in question was a small one, but it has its point. A South Wales firm and a Dutch undertaking were asked to tender for dry-docking, painting and carrying out some engineering work on a 7000-ton steamer. The Welsh firm's tender was £212, whereas the Dutch firm's offer was less than half, viz., £103, and it intimated that it was working day and night shifts without making any extra charge and was in a position to execute all the work in 24 hours. The South Wales concern did not, however, give any specified time in which it was prepared to carry out the work, which of course, is a matter of supreme importance to shipowners. As a consequence the order, small as it is, is being executed at Rotterdam.

Current Business.

There has been comparatively little activity on the steam coal market during the past week, and the position of many collieries has been adversely affected by the delay in the arrival of tonnage due to the bad weather which prevailed last week end. Quite a number of idle berths have been in evidence at the various ports during the last few days, and this can only mean that many collieries are not doing any too well from the point of view of securing the release of wagons to enable the pits to keep on working. At the same time the superior grades of steam coals have not undergone any material alteration so far as price is concerned, but some of the inferior qualities have been irregular. Small coals keep very steady in the case of the better bunker sorts, owing to the restriction in output, but lower qualities are fairly plentiful. The demand for coke and patent fuel continues rather quiet, while anthracite coals remain steady and are well stemmed for some weeks ahead.

Miners' Wages.

The general wage rate for the miners for this month will remain at the minimum of 42.22 per cent. on the 1915 standard rates, as the rate certified by the joint auditors based on the returns for September works out at only 17.6 per cent., compared with 16.08 per cent. in August.

Colliery to Re-start.

Work is to be resumed immediately at the Ynysarwed Colliery, Resolven, which was closed down recently for an indefinite period, resulting in 600 men being idle. Proposals made by the owners as a condition of resumption have been agreed to by the men.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

We are asked to state that the title of "Brown, Boveri and Co., Limited," of Trafalgar House, Waterloo-place, London, S.W. 1, has been changed to British Brown-Boveri, Limited.

We are informed that the ownership of the Unbreakable Pulley and Millgearing Company, Limited, of West Gorton, Manchester, has recently changed, and that the new proprietors have appointed Mr. C. A. Ablett, M. Inst. C.E., as managing director.

We are asked to state that the address of the Associated Portland Cement Manufacturers, Limited, Works Department, has been changed from 6, Lloyd's-avenue, London, E.C. 3, to Portland House, Tothill-street, Westminster, S.W. 1. Communications to the British Portland Cement Manufacturers, Limited, should also be sent to the latter address.

Royal Institution.—A general meeting of the members of the Royal Institution was held on Monday afternoon, November 3rd, Sir James Crichton-Browne, treasurer and vice-president, in the chair. The special thanks of the members were returned to Sir Alfred Yarrow for his generous donation towards the cost of advertising the lectures, and to Mr. Archibald D. Fox for his gift of Michael Faraday's penknife. The chairman announced that the Christmas lectures this year would be delivered by Frank Balfour Browne, Lecturer in Zoology (Entomology) in the University of Cambridge, the subject being "Concerning the Habits of Insects." Mr. A. D. Trencham was elected a member.

Faraday House Old Students' Dinner.—The annual dinner of the Faraday House Old Students' Association was held at the Hotel Cecil on October 31st, Mr. R. N. Vyvyan, M.I.E.E., engineer-in-chief to Marconi's Company and president of the Association, being in the chair. The toast of "Faraday House" was proposed by Mr. W. B. Woodhouse, the president of the Institution of Electrical Engineers. He pointed out that Faradians were holding leading positions in almost every country in the world, and that the work they were doing was of great national importance. In his reply Dr. Alexander Russell, the principal, reported the continued prosperity of the College. The workshops, laboratories and testing rooms had all been practically re-equipped during the past year. He gave a list of recent successes obtained by Faradians. The toast of "The Guests" was proposed by Mr. Charles Sparks and responded to by Sir Charles Morgan, the president of the Institution of Civil Engineers, and by Sir Charles John Snell, the Chief Electricity Commissioner. A letter was read from Mr. W. H. Patchell, the president of the Institution of Mechanical Engineers, regretting his inability to attend as he was in America. Finally, the Right Hon. F. Kellaway proposed the health of "The Chairman." In his reply, Mr. Vyvyan stated that he regretted that the League of Nations did not take up the subject of improving international relations by issuing approved histories of national events. A musical programme concluded a most enjoyable evening. There were about 180 members and guests present.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 24/-
(1) Spanish	23/-
(1) N. African	23/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	21/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 15 0	—
No. 1 Foundry	4 15 0	—
No. 3 Foundry	4 10 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 8 6	4 8 6
No. 1	4 9 6	4 9 6
Cleveland—		
No. 1	4 7 0	4 7 0
Silicious Iron	4 7 0	4 7 0
No. 3 G.M.B.	4 2 0	4 2 0
No. 4 Foundry	4 1 0	4 1 0
No. 4 Forge	4 0 0	4 0 0
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 16 0	—
„ „ Foundry	4 5 0	—
(3) Northampton—		
Foundry No. 3	3 15 0	—
„ Forge	3 10 0	—
(3) Derbyshire—		
No. 3 Foundry	4 1 6 to 4 2 6	
Forge	3 15 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 2 6	—
No. 4 Forge	4 0 0	—
Basic	4 5 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	5 5 0 (a) / 5 10 0 (b)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best „	—	—
N.E. Coast—		
Common Bars	12 0 0	—
Lancs—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 0 0	—
Best „	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 15 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	11 15 0	—
Gas Tube Strip	13 0 0 to 13 5 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ½in. and up	9 15 0	—
Sections	9 10 0	—
Steel Sheets, 5/16in. to ½in.	12 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	18 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	9 15 0	—
Angles	9 10 0	—
Boiler Plates	13 0 0	—
Joists	9 10 0	—
Heavy Rails	9 0 0	—
Fish-plates	13 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	9 5 0†	—
Light „	9 10 0 to 10 0 0†	
Billets	9 0 0 to 11 10 0†	
Manchester—		
Bars (Round)	10 0 0 to 10 10 0	
„ (others)	9 15 0 to 10 0 0	
Hoops (Best)	15 5 0	15 0 0
„ (Soft Steel)	13 15 0	13 10 0
Plates	9 15 0 to 10 0 0	—
„ (Lancs. Boiler)	13 0 0	—
Sheffield—		
Siemens Acid Billets	11 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	
Intermediate Basis	9 0 0	
Soft Basic	8 0 0	—
Hoops	12 10 0	
Soft Wire Rods	11 0 0 to 11 10 0	
Midlands—		
Small Rolled Bars	9 5 0 to 10 0 0	
Billets and Sheet-bars	7 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 10 0 to 17 12 6	
Angles	9 5 0	—
Joists	9 5 0	—
Tees	10 5 0	—
Bridge and Tank Plates	9 15 0 to 10 0 0	
Boiler Plates	13 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	23/6 to 23/7½
Block Tin (cash)	£58 2 6
„ (three months)	£58 2 6
Copper (cash)	£3 17 6
„ (three months)	£65 0 0
Spanish Lead (cash)	£38 12 6
„ (three months)	£36 10 0
Spelter (cash)	£34 8 9
„ (three months)	£34 2 6
Manchester—	
Copper, Best Selected Ingots	£69 10 0
„ Electrolytic	£70 10 0
„ Strong Sheets	£91 0 0
„ Tubes (Basis price)	£0 1 1
Brass Tubes (Basis price)	£0 0 11½
„ Condenser	£0 1 2
Lead, English	£41 0 0
„ Foreign	£40 0 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8½ per lb.	
Ferro Tungsten	1/4½d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
„ 6 p.c. to 8 p.c. „	£22 10 0	7/6
„ 8 p.c. to 10 p.c. „	£23 0 0	7/6
„ Specially Refined		
„ Max. 2 p.c. carbon	£43 0 0	16/-
„ „ 1 p.c. „	£52 0 0	17/6
„ „ 0.75 p.c. carbon	£60 0 0	20/-
„ „ carbon free	1/5 per lb.	
Metallic Chromium	4/2 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
„ Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
„ „ 75 p.c.	£17 17 6 scale 5/- per unit	
„ Vanadium	18/3 per lb.	
„ Molybdenum	7/9 per lb.	
„ Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£155	
Cobalt	10/- per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	17/-
„ „ Ell	18/9
„ „ Splint	19/6 to 22/-
„ „ Trebles	20/9
„ „ Doubles	18/9
„ „ Singles	13/-
Ayrshire—	
(f.o.b. Ports)—Steam	17/-
„ „ Splint	19/6
„ „ Trebles	20/9
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	15/3 to 17/3
Screened Navigation	25/6
Trebles	23/9
Doubles	19/3
Singles	14/-
Lothians—	
(f.o.b. Leith)—Best Steam	16/9
Secondary Steam	15/9
Trebles	21/3
Doubles	19/-
Singles	13/6

ENGLAND.

(8) N.W. Coast—	
Steams	28/6
Household	45/- to 58/6
Coke	31/-
Northumberland—	
Best Steams	18/- to 18/3
Second Steams	17/6 to 18/-
Steam Smalls	10/9 to 11/-
Unscreened	15/6 to 17/-
Household	23/6 to 28/-
Durham—	
Best Gas	20/6 to 21/-
Second	17/3 to 17/6
Household	23/6 to 25/-
Foundry Coke	25/6
Sheffield—	Inland.
Best Hand-picked Branch	32/- to 35/- —
Barnsley Best Silkstone	26/- to 28/- —
Derbyshire Best Brights	27/- to 32/- —
„ „ House	24/- to 26/- —
„ „ Large Nuts	22/6 to 25/- —
„ „ Small „	14/- to 16/- —
Yorkshire Hards	21/6 to 23/6 —
Derbyshire „	21/- to 23/- —
Rough Slacks	9/6 to 12/- —
Nutty „	9/- to 11/- —
Smalls	6/- to 8/6 —
Blast-furnace Coke (Inland)*	— —
„ „ (Export) f.o.b.	25/- to 25/6
Cardiff— (9) SOUTH WALES.	
Steam Coals:	
Best Smokeless Large	27/- to 27/6
Second „	25/6 to 26/6
Best Dry Large	27/6 to 28/-
Ordinary Dry Large	24/- to 26/-
Best Black Vein Large	24/- to 24/6
Western Valley „	23/6 to 24/-
Best Eastern Valley Large	23/- to 24/-
Ordinary „ „	22/6 to 23/-
Best Steam Smalls	15/6 to 16/6
Ordinary „	15/- to 15/-
Washed Nuts	25/- to 32/6
No. 3 Rhondda Large	27/- to 27/6
„ „ Smalls	19/- to 20/-
No. 2 „ Large	22/6 to 24/-
„ „ Through	18/- to 20/-
„ „ Smalls	10/- to 12/-
Foundry Coke (export)	40/- to 47/6
Furnace Coke (export)	27/6 to 32/6
Patent Fuel	25/6 to 27/6
Pitwood (ex ship)	26/6 to 27/-
Swansea—	
Anthracite Coals	
Best Big Vein Large	47/6 to 50/-
Seconds	45/- to 47/6
Red Vein	32/6 to 35/-
Machine-made Cobbles	60/- to 62/6
Nuts	55/- to 62/6
Beans	40/- to 45/-
Peas	20/- to 23/-
Breaker Duff	9/6 to 10/-
Rubbly Culm	11/6 to 12/-
Steam Coals:	
Large	22/6 to 23/6
Seconds	22/- to 22/6
Smalls	14/- to 16/-
Cargo Through	17/- to 19/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast furnaces only, 16/9, with fluctuations according to analysis; open market, round about 22/6 to 25/- at ovens. † Latest quotations available. (a) Delivered Sheffield or Glasgow. (b) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Trade Situation.

Amongst the factors that influence the iron, steel and engineering trades, the high cost of production, by putting up selling prices to a level beyond what consumers can generally pay, is the most serious, because there appears to be no remedy for it until an improvement in the financial position and a reduction of charges shall increase the country's purchasing power. Another factor is the feeling of uncertainty and lack of confidence caused by the Socialist measures that tend to increase the charges upon industry. Every day there are proposals and Bills before Parliament that keep the industrial community in a perpetual state of unrest. One of the proposals is to encourage a revival of the apprenticeship system by imposing heavy taxes upon those employers who do not admit apprentices into their works. Seeing that apprenticeship dropped out on account of the intolerable restrictions enforced wherever lads were employed, the employer will be placed in a dilemma, for if the present legislation is not modified he will either not be master of his own business or he will find the already crushing charges increased. Altogether the situation is not satisfactory, and for the first time there appears to be a certain amount of unemployment, which leads to the fear that it may become accentuated during the winter.

The Engineer's Status.

There have been many complaints that the engineering profession is overcrowded. The number of schools that grant diplomas has largely increased of late years, and the facilities offered for training are taken full advantage of by parents who look upon engineering as a remunerative career for their sons, but as the ranks are swollen with each "promotion" the engineering industry is quite unable to absorb all the aspirants leaving school with diplomas. The plethora of applicants for situations is therefore seriously affecting the financial status of engineers. The Chambre Syndicale des Ingénieurs has found it necessary to warn parents against sending their sons into an already overcrowded profession, and has requested the directors of technical schools to reduce considerably the number of "promotions." At the same time, it urges upon employers the necessity of adjusting salaries of engineers to the importance of their functions and thereby raising the status of the profession generally.

The Tournelle Bridge.

The Tournelle Bridge across the Seine in Paris was constructed in 1654. On account of its very wide piers it offered a serious obstacle to the flow of the river, and when measures had to be taken to minimise the risks of flood the Tournelle Bridge was condemned. During 1919 the temporary spell of unemployment was taken advantage of to demolish the bridge, which was replaced by a footbridge until the new construction was completed. It was only recently, however, that work on the new structure could be started, and enormous caissons are being built for the two reinforced concrete abutments which are to support the single-span bridge. The arch is to have a span of 73.8 m., and with the abutments the total length of the bridge will be 108 m. Built with reinforced concrete, faced with stone, it will comprise three ribs side by side with spaces between them of 2.5 m. The width of the bridge at the centre will be 20 m. and at the ends 24 m. It will be particularly flat for a single-span bridge and will be adorned at one end with a huge column supporting an allegorical figure.

Motor Traffic in Africa.

An interesting experiment is to be carried out by Messrs. Tranin and Duverne, who have sailed from Bordeaux for Konakry with a motor car which is to carry them across the Sudan to Djibouti. The explorers hope to open up a motor route across the Sudan and show that it is possible to employ motor cars for the development of the African Colonies. What makes the attempt more interesting is that the explorers will endeavour to run the car exclusively on synthetic petrol produced, as required, from vegetable oils with the aid of catalysers they are taking with them. This question of synthetic petrol is arousing considerable discussion amongst scientists, who declare that it is a serious mistake to lead the public into believing that the catalytic process of Professor Maihle is a commercial success before it has been submitted to competent bodies for investigation. The process is being patronised by the State institutions, the Laboratoire des Recherches Scientifiques at Belleville, and the Comité Central de Culture Mécanique, but the far more important research body organised by all the oil and other fuel interests in the country has been left out in the cold. This body, as well as many chemists, urge that the claims on behalf of synthetic petrol should be received with scepticism until they are proved. The experiment of Messrs. Tranin and Duverne may throw some light upon this matter.

Railwaymen.

The threat of the Minister of Public Works to take measures against the railway companies if they refuse to obey his order to reinstate the men discharged after the great strike has had no effect upon them, and except for the State railways, on which the reinstatements have been fairly complete, few, if any, have been taken on by the companies. The Socialist Railwaymen's Union is putting constant pressure upon the Government to persist in its action, and has even obtained from the Minister of Public Works a promise that the men's wages shall be raised. Meanwhile, the Minister has obtained nothing from the companies except an offer that they are prepared to investigate individual cases and take on such hands as they deem fit as places are open to them. They claim to be their own masters, and refuse to submit to pressure on any question affecting the internal organisation of their lines.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

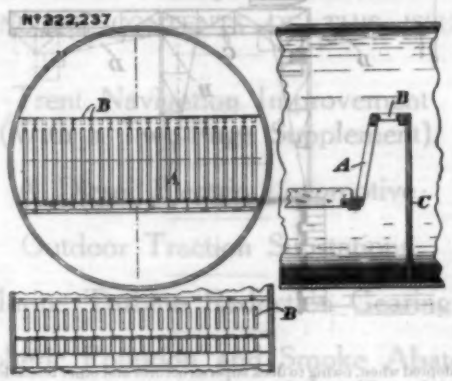
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

STEAM GENERATORS.

222,237. July 7th, 1923.—Improvements in Furnace Fire-bridges, John Newnes, of 4, Mill-street, Burslem, Stoke-on-Trent.

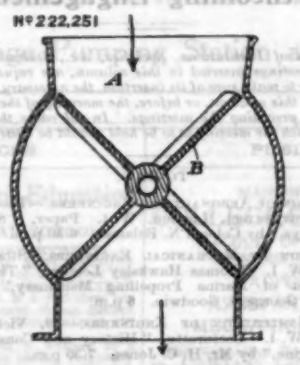
The inventor's object is to overcome smoke nuisance. The fire-bridge described in the specification consists of one or more



blocks of metal or other refractory material, having vertical slots A formed in the front portion and horizontal slots B in the top portion. The draught or baffle plate C is also composed of metal or similar material.—*October 2nd*, 1924.

222,251. July 8th, 1923.—A Mechanical Stoker for Steam Wagons, Frederick Arthur Murphy, of 312, Gorton-road, Reddish, Stockport.

The inventor's object is to dispense with hand firing on motor wagons. The arrangement shown in the drawings is fixed over

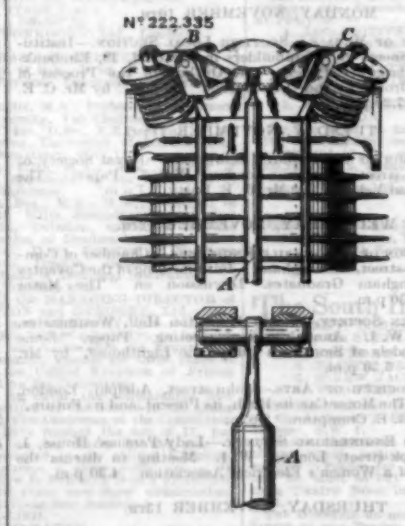


the fire-box, and the taper part A is filled with fuel. As the rotor B, which is divided into chambers or compartments, is rotated, it carries the fuel round until it is delivered or dropped into the fire.—*October 2nd*, 1924.

INTERNAL COMBUSTION ENGINES.

222,335. October 30th, 1923.—Improvements in Overhead Valve Mechanism for Fluid Pressure Engines, Armstrong-Siddeley Motors, Limited, and Spirito Mario Viall, both of Armstrong-Siddeley Works, Park Side, Coventry.

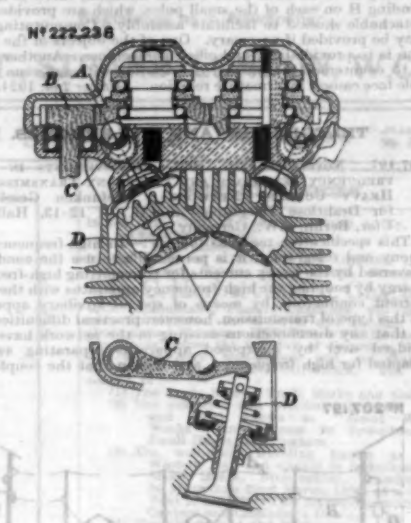
As shown in the drawing, a single tappet rod A operates the



two valve rockers B and C, and there is a separate universal joint and sliding connection for each rocker, as shown in the lower illustration.—*October 2nd*, 1924.

222,238. July 7th, 1923.—Improvements in and relating to Valve Gear for Internal Combustion Engines, Albert Bury, of "Glendare," Stanley-road, Heysham, near Morecambe, Lancashire.

The overhead valves of the engine are actuated by one or more

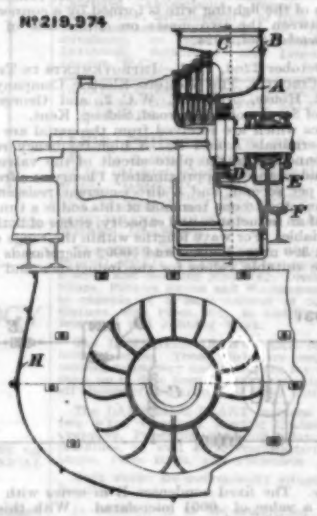


rotary face cams situated over the ends of the valves. There are two cams. In the drawing A designates the cam members, B the driving pinion, C the rockers, and D the poppet valves.—*October 2nd*, 1924.

TURBINE MACHINERY.

219,974. July 30th, 1923.—Improvements in or relating to Elastic Fluid Turbines, *The British Thomson-Houston Company, Rugby.*

The object of this invention is to construct the turbine with a comparatively light exhaust head. An end wall A is provided, and connected to it by radially extending webs B is a ring C,

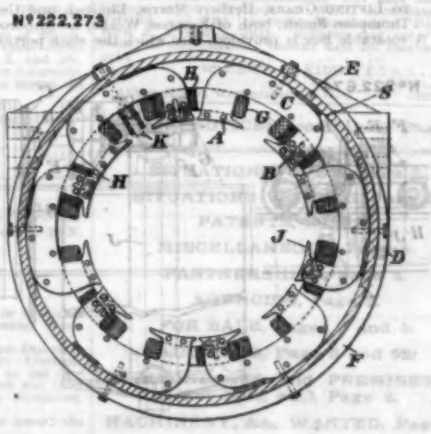


which is bolted to the low-pressure end of the casing. The wall A is dished or curved inwardly around the shaft, and packing supports D, the bearing support E and the foot F are cast with it. An exhaust housing H is used, which may be formed of sheet iron, and this is bolted to the housing of the rigid frame.—*October 2nd*, 1924.

DYNAMOS AND MOTORS.

222,273. August 11th, 1923.—Improvements in Dynamo-electric Machines, Tilling-Stevens Motors, Limited, and Harold Kenneth Whitehorn, both of Victoria Works, Maidstone, Kent.

The frame magnet of the dynamo described in this specifica-



tion is composed of laminated magnets, provided with a pole section A of comparatively large area and a section B, of comparatively small area, and connected by a yoke C, which is

reduced in area on the side near the pole with the smallest area. The magnets are assembled in a frame D, which does not form part of the magnetic circuit. It consists of a thin aluminium ring E, with strengthening rings F. Intermediate packing pieces of non-magnetic material are provided at S. A shunt or series winding G is on each pole, and, in addition, there is a series winding H on each of the small poles, which are provided with detachable shoes J to facilitate assembly. Commutating poles may be provided if necessary. One of the objects of the invention is to provide light and efficient machines. Another object is to counteract the uneven distribution of magnetism of the pole face caused by armature reaction.—*October 2nd*, 1924.

TELEGRAPHS AND TELEPHONES.

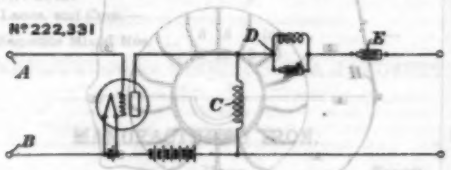
207,197. November 17th, 1923.—Improvements in High-frequency Telegraph and Telephony Transmission in Heavy Current Networks, Telefunken Gesellschaft für Drahtlose Telegraphie m.b.H., of 12–13, Hallesches Ufer, Berlin, S.W., Germany.

This specification reads as follows:—In high-frequency telephony and telegraphy, it is permissible to use the conductors traversed by the heavy currents for transmitting high-frequency energy by coupling the high-frequency apparatus with the heavy current conductors, by means of special auxiliary apparatus. In this type of transmission, however, practical difficulties arise, in that any disconnections existing in the network have to be bridged over by interposed apparatus separating switches adapted for high frequency; and also in that the couplings of

the apparatus with the heavy current conductors cannot be carried out in a simple manner. According to this invention the earth conductor (lightning wire) is used for transmitting the high-frequency energy used for signalling, the earth conductor in heavy current network generally being introduced alongside the heavy current conductor. The transmitting and receiving apparatus serving for high-frequency telegraphy and telephony is connected with this earth wire. In the drawing A is a lighting wire, B the high-voltage wire. The high-frequency apparatus D is shown connected between the lighting wire and earth at the two end stations. When a portion C of the high-voltage conductor is in the form of a cable, a continuous connection over this portion of the lighting wire is formed by a connecting piece inserted between the two masts on either side of the cable portion.—*October 2nd*, 1924.

222,331. October 22nd, 1923.—Improvements in Thermionic Tube Circuits, The Western Electric Company, of Connaught House, Aldwych, W.C. 2, and George Howard Nash, of Southwold, Elm-road, Sidcup, Kent.

The waves which are received from the aerial are impressed upon the terminals A and B. A high-frequency retardation coil C is connected in the plate circuit of the valve, this coil having an inductance of approximately 1 henry at a frequency of 900 cycles per second, and a direct-current resistance of 600 ohms. Connected to one terminal of this coil is a tuned circuit, consisting of an inductance and capacity, either of both of which may be variable. For wave lengths within the range of 300 and 450 metres, 300 micro-henries and .0002 microfarads have been found to be suitable values for the inductance and condenser

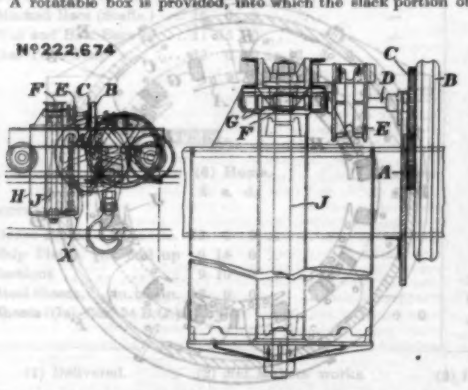


respectively. The fixed condenser E in series with the tuned circuit has a value of .0001 microfarad. With this arrangement, it is possible to form two selective circuits, the first consisting of the inductance and condenser, shown at D and condenser E forming an acceptor circuit, and giving a high E.M.F. across the grid and filament of the second valve, whilst the second circuit, consisting of the condenser and inductance shown at D forms a rejector circuit, and allows only a fraction of the E.M.F.'s of undesired wave lengths to be applied to the grid circuit of the second valve. With the arrangement high selectivity is obtained, and it has been found possible to operate a receiving set embodying this invention in London for the reception of signals from a distant station operating on a wave length between 300 and 500 metres without interference from the London station, operating at 369 metres.—*October 2nd*, 1924.

CRANES AND CONVEYORS.

222,674. October 6th, 1923.—Improvements in or relating to Lifting Gears, Herbert Morris, Limited, and George Thompson Smith, both of Empress Works, Loughborough.

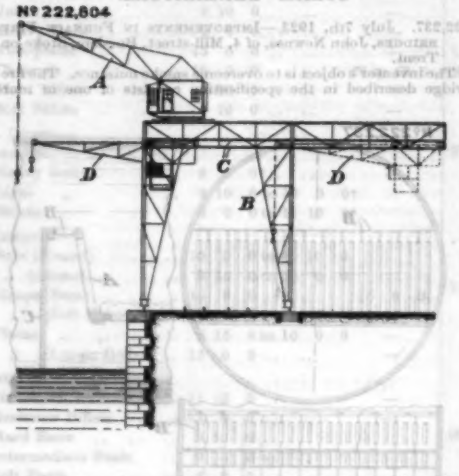
A rotatable box is provided, into which the slack portion of



the load chain is led. The spur wheel A attached to the main load wheel B is geared to a spur wheel C mounted on the shaft D, and carrying a pocketed chain wheel E. A worm F, which is integral with the shaft D, meshes with a worm wheel G, connected with an upright cylinder or box H, so that the box rotates on a fixed spindle J. The slack end of the load chain X, which is attached to the bottom of the circular box, passes over the pocketed wheel E and hangs in a short loop between this wheel and the main load wheel B. The box collects the slack portion of the load chain as the lifting hook rises.—*October 9th*, 1924.

222,804. June 27th, 1924.—Improvements relating to Gantry Cranes, Paul Uellner, of Achenbachstrasse 15, Dusseldorf, Germany.

It is explained in this specification that port cranes have been used in which a gantry is provided, with a normal revolving crane, and having beneath the latter a retractable jib with a crab travelling in such a manner as to allow of working with the revolving crane in the same ship's hatch, the arrangement being



adopted when, owing to deck superstructures and other obstacles, it is impossible to employ two revolving cranes simultaneously. There are, however, several disadvantages in this arrangement, and the object of the present invention is to overcome those disadvantages. In the drawing, A denotes a revolving crane erected on the gantry B. Beneath this revolving crane there are rails C, and on those rails the jib crane D runs. More than one jib may be provided if desired.—*October 9th*, 1924.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Aeronautical Engineers.—The Engineers' Club, Coventry-street, London, W. 1. Paper, "Steel *versus* Lighter Alloys," by Colonel N. Belaiew. 6.30 p.m.

Institution of Mechanical Engineers.—Storey's Gate, London, S.W. 1. Thomas Hawksley Lecture, "The Trend of Development of Marine Propelling Machinery," by Vice-Admiral Sir George G. Goodwin. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "History and Construction of the Fire-engine," by Mr. H. C. Jones. 7.30 p.m.

TO-DAY and till SATURDAY, NOVEMBER 15th.

Smoke Abatement Exhibition at the City Exhibition Hall, Deansgate, Manchester.

SATURDAY, NOVEMBER 8th.

Institute of Marine Engineers.—85–88, The Minories Tower-hill, London, E. 1. Junior Section social and dance 7 p.m.

Institution of Municipal and County Engineers.—Council Chamber, Town Hall, Leeds. Quarterly meeting of the Yorkshire District. 2.30 p.m.

MONDAY, NOVEMBER 10th.

Institute of Metals: Scottish Local Section.—Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. Paper, "An Outline of the Process of Casting in Bronze by the 'Cire Perdue' Method," by Mr. C. E. Henshaw. 7.30 p.m.

TUESDAY, NOVEMBER 11th.

Institution of Automobile Engineers.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Electric Road Vehicle," by Mr. D. E. Batty. 7 p.m.

WEDNESDAY, NOVEMBER 12th.

Institution of Automobile Engineers.—Chamber of Commerce, New-street, Birmingham. Joint meeting of the Coventry and Birmingham Graduates. Discussion on "The Motor Show." 7.30 p.m.

Newcomen Society.—Room 1, Caxton Hall, Westminster, London, S.W. 1. Annual general meeting. Paper, "Some Original Models of Smeaton's Eddystone Lighthouse," by Mr. T. Rowatt. 5.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2.—"The Motor Car, its Birth, its Present, and its Future," by Colonel R. E. Crompton. 5 p.m.

Women's Engineering Society.—Lady Parsons' House, 1, Upper Brook-street, London, W. 1. Meeting to discuss the formation of a Women's Electrical Association 4.30 p.m.

THURSDAY, NOVEMBER 13th.

Institute of Metals: London Local Section.—Royal School of Mines, South Kensington, London, S.W. 7. "Oxidation, with Special Reference to Thin Films," by Professor T. Turner. 8 p.m.

Institution of Civil Engineers: Birmingham and District Association.—Room 7, Chamber of Commerce, Birmingham. Introduction of the President, Mr. J. H. Willcox. Paper, "Pipes and Pipe Lines," by Mr. T. Stanford Griffin. 5.30 p.m.

Institution of Engineering Inspection.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Development of Long and Short Wave Wireless Signalling," by Mr. A. P. Welch. 5.30 p.m.

Optical Society.—Imperial College of Science and Technology, South Kensington, London S.W. 7. Papers, "The Back Vertex Power of a Combination of Lenses," and "The Theory of Neutralisation," by Mr. T. Smith; "A New Type of Nephelometer," by Mr. R. Kingslake. 7.30 p.m.

FRIDAY, NOVEMBER 14th.

Diesel Engine Users' Association.—The Engineers' Club, Coventry-street, London, W. 1. Further report of the Committee on "Heavy Oil Engine Working Costs." 3.30 p.m.

Institute of Metals: Swansea Local Section.—Metallurgical Department, University College, Singleton Park, Swansea. Paper, "The Inner Structure of Alloys," by Dr. W. Rosenhain, F.R.S. 7.15 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Annual general meeting. 7 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. "Girders in Ships," by Mr. J. Foster King. 7.30 p.m.

SATURDAY, NOVEMBER 15th.

Institute of British Foundrymen: Birmingham Branch.—Visit to the works of Harper, Son and Bean, Limited, at Dudley.

MONDAY, NOVEMBER 17th.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Paper, "The Maintenance of Commercial Vehicle Fleets," by Major E. G. Beaumont. 7.30 p.m.

TUESDAY, NOVEMBER 18th.

Institute of Marine Engineers.—85/88, The Minories, Tower Hill, London, E. 1. "The Influence of Internal Combustion Engines on the Design of Merchant Ships," by Mr. J. McGovern. 6.30 p.m.

Institution of Automobile Engineers: Wolverhampton Centre.—Star and Garter Hotel, Wolverhampton. Paper, "The Maintenance of Commercial Vehicle Fleets," by Major E. G. Beaumont. 7.30 p.m.

WEDNESDAY, NOVEMBER 19th.

British Cast Iron Research Association.—Institution of Mechanical Engineers, Storey's Gate, London, S.W. 1. Fourth annual meeting. 3.30 p.m.

Institution of Automobile Engineers.—Connaught Rooms, Great Queen-street, London, W.C. 2. Annual dinner. 7.30 p.m.

University of London.—University College, Gower-street, London, W.C. 1.—"High-frequency Electric Measurements." Lecture IV., "Measurement of Electric Power and Energy," by Professor J. A. Fleming. 5 p.m.

THURSDAY, NOVEMBER 20th.

Institution of Automobile Engineers.—Watergate House, Adelphi, London, W.C. 2. London Graduates' meeting. Discussion on "The Motor Cycle Show," opened by Messrs. D. S. D. Williams and C. A. Partridge. 7.30 p.m.

FRIDAY, NOVEMBER 21st.

Institution of Engineers and Shipbuilders in Scotland.—Grosvenor Restaurant, Gordon-street, Glasgow. "James Watt" dinner. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street London, S.W. 1. Lecturette, "Stainless Steel," by Mr. J. G Hoperaft. 7.30 p.m.

Junior Institution of Engineers: North-Western Section.—Manchester Geographical Society's Rooms, 16, St. Mary's Parsonage, Manchester. Lecture, "Powdered Fuel," by Mr. George E. Blythe. 7.15 p.m.

SATURDAY, NOVEMBER 22nd.

Institution of Automobile Engineers.—London Graduates' visit to the works of the South Metropolitan Gas Company, 709, Old Kent-road, London, S.E. 2.30 p.m.

TUESDAY, NOVEMBER 25th.

Institute of Marine Engineers.—85/88, The Minories, Tower Hill, London, E. 1. "The Rôle of Technical Training in Marine Engineering," by Mr. D. Laughame Thornton. 6.30 p.m.

Institution of Automobile Engineers.—Broadgate Café, Coventry, Coventry Graduates' meeting. Paper, "Body Building," by Mr. W. W. Small. 7.15 p.m.

Institution of Automobile Engineers.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Informal meeting. Demonstration and discussion on car cleaning devices. 7 p.m.

WEDNESDAY, NOVEMBER 26th.

Institution of Automobile Engineers.—Birmingham Graduates' visit to Aerial Works, Limited, Bournbrook. 2.30 p.m.

Institution of Automobile Engineers: North of England Centre.—Milton Hall, 244, Deansgate, Manchester. Paper, "Automobile Coachbuilding," by Mr. Martin. 6.30 p.m.

THURSDAY, NOVEMBER 27th.

Institution of Automobile Engineers.—Training School of Vauxhall Motors, Limited, Luton. Luton Graduates' meeting. Paper, "Production," by Mr. G. D. Ricketts. 7.30 p.m.

Motor Lifeboat for the Isle of Wight.—A motor lifeboat, built by the Royal National Lifeboat Institution for the Isle of Wight, left the building yard at Cowes for her station on October 31st. She is of the latest type, a Watson lifeboat, 45ft. by 12ft. 6in., with an 80 horse-power engine and a cabin, and is to be stationed at Yarmouth, Isle of Wight, replacing there the pulling and sailing lifeboat at Totland Bay. The Totland Bay station was established in 1885 and is now being closed, Yarmouth taking its place, as it was found that it would be very difficult and expensive to make satisfactory arrangements for launching a large motor lifeboat at Totland Bay. There are now motor lifeboats at each end of the Isle of Wight, the other being at Bembridge.